A. Cliff Lilly
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PRELIMINARY

CONFIDENTIAL

1988

R&D OPERATIONAL PLANS

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PROPOSED PRIORITY PROGRAMS

1.	Menthol	J. Myracle; R. Heretick
2.	Low Tar/High Taste	J. Myracle; H. Spielberg
3.	Art	D. Knudson; H. Alonso; H. Spielberg
4.	Reduced Density Rod	D. Knudson; E. Craze
5.	Project Tomorrow	J. Charles; J. Whidby
6.	Reduced Sidestream	J. Charles; R. Ferguson
7.	International Product Support	J. Myracle; R. Heretick
8.	Operations Support	W. Kuhn; R. Cox
9.	Alternate Humectant	J. Charles; R. McCuen
10.	TSNA	J. Charles; C. Ellis
11.	Lowered Biological Activity	J. Charles; C. Ellis
12.	Project Delta	C. Lilly; E. Sanders
13.	Filter Research	J. Myracle; P. Gauvin
14.	Optical Processing	J. Charles; J. Whidby

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Menthol

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MENTHOL PRODUCT DEVELOPMENT
OPERATIONAL PLANS
1988/89

Note: The remainder of the 1988 Menthol Program has been included in the 1988/89 Domestic Product Development Operational Plans.

Willie Houck

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .Mr. A. C. Lilly **Date:** August 9, 1988

From: .R. P. Heretick

Subject: .MENTHOL PROGRAM

There are no major changes in the plans for the menthol program.

R. P. Heretick

RPH:da

cc: W. G. Houck, Jr.

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MENTHOL DEVELOPMENT
OPERATIONAL PLANS
1988

Objective

To develop new menthol products to compete with current free-standing menthol brands on the USA market.

Status and Background

Since P.M.'s share of the free-standing menthol market has historically been below the company's overall market share, the need exists for market penetration into this area.

Past attempts to penetrate the free-standing menthol market with essentially renamed P.M. type menthol products has been largely unsuccessful, the need exists to explore alternate blend, flavor and design systems. In 1985 a special menthol panel was created to study and understand competitive products. From this work, blend and Flavor systems were developed to better match that of the three major competitors, Kool, Salem, and Newport.

The new Marlboro, Marlboro Lts., and P.M. Blues Menthol products are a direct outgrowth of the special panel work. Other products to more closely match Kool, Salem, and Newport and currently in early development stages.

Menthol-on-foil is currently being specified for new menthol products for ease of manufacture and application uniformity. Both filler applied and menthol-on-foil applied products are being studied for aging and environmental effects. Product rotation recommendations are under consideration.

Cigarette specifications have and are becoming more complete and detailed, especially in the area of nontobacco components that have subjective effects on menthol presentation.

Strategies

1. Understand menthol application, cigarette equilibration, menthol delivery, and product aging and storage.

2. Develop K, N, and S POL type products via internal testing, the Moog Mapping Panel, and continue blend development/A/C development for targeted/specialized products.

3. Continue brand development/maintenance through brand family development and modifications. Introduce new/modified products such as Marlboro menthol, Trim, Recessed Menthol and Value Entries. (Alpine and Target)

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Tactics/Timetable

1. Complete menthol tracking, aging and storage studies — 4th Qtr. '88

2. Prototype development for K, N, S competitors — 2nd Qtr. '88
   - 200 prototypes

3. POL Testing/Moog Mapping — Cont. '88
   - 30-40 Tests

4. New Filter/Filter Modifications/ additives such as: — 4th Qtr. '88
   - Sorbitol
   - PVA Menthol
   - PZ Studies
   - Aging Studies
   - Internal Screening
   - POL Testing

5. A/C and casing modifications — 2nd Qtr. '88
   - Menthol Enhancer

Resource Allocations

1. Domestic Product Development (Personnel Needed)

Professional	1.0
Technicians	0.5

2. Support Personnel Needed
   - Flavor
   - Semiworks
   - Analytical
   - Oper. Serv.
   - PED

3. Needs
   - Filter Expertise
   - Blend/Flavor Expertise
   - Analytical Expertise
     - Blend Components
     - Flavor Components
   - Product Testing Expertise
     - In-house
     - POL

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Impact

Areas impacted or affected by menthol program.

Flavor Development

Filter Development

Blend Development

Product Development

Semiworks

Analytical

- Analytical Sr.
- Operations Support
- Other

PED

Engineering

Operation Serv.

Manufacturing

Suppliers

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Low Tar/High Flavor

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

CONFIDENTIAL

To: Mr. J. Myracle

Date: August 1, 1988

From: H. L. Spielberg

Subject: Low Tar/High Flavor - Operating Plan Revised

Attached is the revised Operating Plan for Low Tar/High Flavr. Your review and comments would be greatly appreciated.

H. L. Spielberg

HLS:lgk

Attachment

cc: Mr. W. Claflin
Dr. R. Cox
Dr. R. Ferguson
Mr. P. Gauvin
Dr. E. Gee
Mr. R. Heretick
Mr. W. Houck
Dr. A. Kallianos
Mr. G. Keritsis
Mr. C. Lilly

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"Low Tar/High Flavor"

Objective

- Establish the capability to produce a "no tar" cigarette with subjective acceptability. By identifying, driving and utilizing the technologies to achieve this goal, advances will be channeled to ongoing cigarette development projects for intermediate term and short-term objectives. Projects such as low delivery cigarettes with flavor responses of cigarettes of twice the tar, should be demonstrable in 1989 while a no tar cigarette with the requisite subjectives will be obtainable in 1993.

August 1, 1988

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- **STRATEGIES**:

I. Flavor Research and Development

II. Cigarette Product Development

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Strategy I: Flavor Research and Development

Tactics:

A. Identification of Important Flavor Components of Tobacco and Smoke

- Review literature.

A detailed literature search of internal documents previously compiled, will be reviewed. Current literature is continuously reviewed.

- Flue cured tobacco glycoside fractions.

Subjective evaluations of fractions complete.

Additional fractionation and identifications to be conducted.

3rd Qtr. '88

- SCF, CO_2 soluble materials from tobacco.

Isolate, fractionate analyze and evaluate.

4th Qtr. '88

- Fractionation of smoke for analytical and subjective evaluations.

Initiate 4th Qtr. '88

- Establish sourcing of required materials.

Ongoing

B. Develop "Controlled" Flavor Release Capabilities from Filler and Filter

- Nature identical precursors and cooked flavor

Test Prototypes 4th Qtr. '88

- Thermal release compounds

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C. Filter Research and Development - Develop filter system which enhances first puff and increase subjective response.

- "Tube in paper" filters 3rd Qtr. '88
- pH modifications 2nd Qtr. '88
- Filter design for low density 1st Qtr. '89
- Misc. filter constructions Ongoing

D. Incorporate Advances in "Spinoff" Projects.

- Half Pint - Complete current testing.

2nd Qtr. '88

Consider additional improvements.

3rd Qtr. '88

- 202 - New Merit Super Lights - develop lowest possible tar cigarette with subjective parity to MUL.

4th Qtr. '88

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Discussion of Resource Allocations for Strategy I:

- One person, totally committed to Tactics A and B would be required to organize and integrate the Research and Development efforts.

Resources:

Tactic A

People:	Chemical Reseach	2.5
	Flavor Development	2.75
	Cigarette Prod. Dev.	0.5
	Product Evaluation	0.5
	Tobacco Processing	0.6
	Cigarette Testing	0.5
	Technical Infor. Ser.	0.25
Equipment:	Smoking Machine	
	Analytical Equipment	
	GC/MS	
	IR	
	Extraction	
	Separatory Col.	
	Freeze Drying	
Outside	Separation Specialist (Sepracor)	

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Resources:

Tactic B

People:	Chemical Research	1.0
	Analytical Research	0.5
	Flavor Development	1.0
	Cigarette Prod. Dev.	0.5
	Cigarette Technology	0.5
	Product Evaluation	0.5
	Tobacco Processing	0.5
	Computer Applications	0.5
Equipment:	Encapsulation equipment, spray dryer, Kaymich applicator	
Outside	GF, Celanese, 3M, Flavor Houses, Miller Brewing	
Resources:	Encapsulation or Flavor Entrapment Technology	

Tactic C

People:	Chemical Research	0.5
	Analytical Research	0.5
	Flavor Development	0.25
	Biochemical Research	1.0
	Technical Info. Ser.	0.25
	Computer Applications	0.5

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Strategy II: Cigarette Product Development - Develop Low Delivery Cigarettes using new and available technologies and establish "spin-off" products for current projects.

Tactics:

A. Blend Development:

- High Flavor Blends

LDB-2M established and tested

New blends underdevelopment

To be tested 3rd - 4th Qtr. '88

- High Alkaloid Blends

50% expanded burley, developed and being evaluated on "Mapping" Panel

Additional blends including material being evaluated.

Consumer testing 4th Qr. '88

B. Density Control:

- Incorporate Low Delivery blends into "Low Density" program generating cigarette models using at least 25% less tobacco.

- Develop casing and flavor sytems for Low Density Rod. 3rd Qtr. '88

- Develop filter systems for Low Density Rods. 3rd Qtr. '88

- Initiate consumer testing. 4th Qtr. '88

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Phase 3 clearance obtained on several materials: menthol, acids, pyrazine release compounds.

Commercial supply of selected materials

3rd & 4th Qtr. '88

- Encapsulated or entrapped flavor

Detailed plan for development of encapsulated flavors being drafted - (Proposal 8/88)

Biologically encapsulated product under consideration.

Evaluate prototyped in Ultra Low Tar cigarette models and Delta.

1st Qtr. '89

C. Investigate Trigeminal Segments of Cigarette Smoke Response

- Review Literature
- Input from Chemical Senses Group
- Identify appropriate flavor material.

4th Qtr. '88

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Discussion of Resource Allocations for Strategy II:

In addition to the requirements from Strategy I, the following resources would be required:

People:	Cigarette Prod. Dev.	1.0
	Cigarette Technology	0.5
	Tobacco Fundamentals	2.0
	Flavor Development	0.5
	Tobacco Processing	1.5
	Cigarette Testing	1.5
	Product Evaluation	1.5
	Computer Applications	0.3
Outside Resources:	Blend Development	
	Operations Services	
	Manufacturing	

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Summary of Resource Allocations for "Low Tar/High Flavor"

Division	Man Power Estimates
Cigarette Product Development	2.0
Flavor Development	4.5
Cigarette Technology	1.0
Product Evaluation	2.5
Tobacco Processing	2.6
Biochemical Research	1.0
Analytical Research	1.0
Chemical Research	3.0
Cigarette Testing	2.0
Computer Applications	1.3
Administrative Services	1.1
Technical Information Services	0.5

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"Low Tar/High Flavor"

Objective

- Establish the capability to produce a "no tar" cigarette with subjective acceptability. By identifying, driving and utilizing the technologies to achieve this goal, advances will be channeled to ongoing cigarette development projects for intermediate term and short-term objectives. Projects such as low delivery cigarettes with flavor responses of cigarettes of twice the tar, should be demonstrable in 1989 while a no tar cigarette with the requisite subjectives will be obtainable in 1993.

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- **Status and Discussion**: For two years the stated objective was to produce a cigarette with the subjective response of a cigarette with twice the analytical tar. As a long-term program, the development of a "No Tar" cigarette will channel our resources in directions which will provide intermediate benefits. The Low Tar/High Flavor program has provided benefits in several projects. Project Half Pint utilizes a new blend developed for low delivery cigarettes and a new flavor system incorporating Super Juice II to boost the flavor response. This product has tested well in consumer testing. Additional teachings have been applied to Projects Studio and Trim.

The basis for this program, however, require reevaluation, defining and commitment. Flavor and filter research as well as cigarette construction and filler material all need direction and commitment.

Many areas explored in the past and put aside such as salt casing, center core cigarette, low tar filler, cigarette paper composition, selective filtration, coal temperature, etc. need to be reevaluated, and promising areas identified and pursued.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

- **STRATEGIES**:

I. Flavor Research and Development
II. Cigarette Product Development
III. Filler Composition Manipulation
IV. Cigarette Construction Research & Development
V. Filter Research and Development
VI. Chemical Senses and Consumer Research

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Strategy I: Flavor Research and Development

Tactics:

A. Identification of Important Flavor Components of Tobacco and Smoke

- Review of Literature
- Complete Evaluation of F.C. glycoside fractions
  2nd Qtr. '88
- Continue evaluations of tobacco components for subjective characteristics.
  Ongoing
- Establish sourcing for required materials
  Ongoing
- Fractionation of smoke for analytical and subjective evaluation.
  Complete 1st Qtr. '90

B. Develop Controlled Flavor Release Capabilities from Filler and Filter

- Nature identical precursors and cooked flavor
  Test Prototypes 4th Qtr. '88
- Thermal release compounds
  Commercial supply of selected materials
  3rd Qtr. '88
- Encapsulated or entrapped flavor
  1st Qtr. '89

C. Investigate Trigeminal Segments of Cigarette Smoke Response

- Review Literature
- Input from Chemical Sense Group
- Identify appropriate flavor material.
  Complete 4th Qtr. '88

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Discussion of Resource Allocations for Strategy I:

- One person, totally committed to Tactics A and B would be required to organize and integrate the Research and Development efforts.

Resources:

Tactic A

People:	Analytical (FD/CR)	3
	Chemical (CR/FD)	1
	Development (FD/CD)	2
	Subjective (PED)	1
	Library	.25
	Semiworks	1
Equipment:	Smoking Machine	
	Analytical Equipment	
	GC/MS	
	IR	
	Extraction	
	Separatory Col.	
	Freeze Drying	
Outside	Separation Specialist (Sepracor)	

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Resources:

Tactic B

People:	Analytical (AR)	1
	Chemical (FD/CR)	1
	Development (FD/CD/CT)	.5
	Subjective (PED)	.25
	Semiworks	.5
Equipment:	Encapsulation	
Outside Resources:	GF, Celanese, 3M, Flavor Houses	
	Encapsulation or Flavor Entrapment Technology	

Tactic C

	Analytical	1
	Chemical	1
	Development	0.5
	Chemical Senses	1
	Library	.25
	Semiworks	.25

2021555607

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Summary of Manpower Needs:

Flavor Development	4
Cigarette Development	1.5
Chemical Research	3.5
Analytical Research	3
Cigarette Technology	.5
Product Evaluation	1.25
Chemical Senses	1
Semiworks	1.75
Library	.5

Comments:

Strategy I combined with Reduced Density Rod and Filter Research/Product Development programs will enable achieving the development of a cigarette with subjective response equal to that of one with twice the analytical tar. However, to approach the goal of a "No Tar" cigarette, it is suggested that Strategies III-VI be considered. The following approach is proposed:

- Establish a "Fact Finding" group to provide information; constraints and needs, which will be the basis for a Plan.
  - Identify key questions and issues to be addressed.
  - Identify key people, resources and conduct discussions--within time constraints.
  - Prepare brief recommendations in each of the Five Strategies.
  - Discuss implementation of these recommendations, i.e. people, time, resources.
  - Recommend appropriate intermediate targets and goals.

Planning stage to be completed by June 1, 1988.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Strategy II: Cigarette Product Development - Develop Low Delivery Cigarettes using new and available technologies and establish "spin-off" products for current projects.

Tactics:

A. Blend Development - Using the talents of the "Blend Development Group" and TLA, have new Low Delivery blends developed which have increased response and lowered available tar.

- High Flavor Blend — 2nd Qtr. '88
- High Nicotine Blend — 2nd - 3rd Qtr. '88

B. Density Control - Incorporate Low Delivery blends into "Low Density" program generating cigarette models using at least 25% less tobacco.

- Develop casing and flavor sytems for Low Density Rod. 3rd Qtr. '88
- Develop filter systems for Low Density Rods. 3rd Qtr. '88
- Initiate consumer testing. 4th Qtr. '88

C. Filter Research and Development - Develop filter system which enhances first puff and increase subjective response.

- "Tube in paper" filters — 3rd Qtr. '88
- pH modifications — 2nd Qtr. '88
- Misc. filter constructions — Ongoing

D. Incorporate Advances in "Spinoff" Projects.

- Half Pint - Complete current testing. 2nd Qtr. '88
  Consider additional improvements. Ongoing
- 202 - New Merit Super Lights - develop lowest possible tar cigarette with subjective parity to MUL. 4th Qtr. '88

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Discussion of Resource Allocations for Strategy II:

In addition to the requirements from Strategy I, the following resources would be required:

Cigarette Development	.5
Filter R&D	.5
Tobacco Fundamentals	2.0
Blend Development	1.0
Semiworks	2.0
Cigarette Testing	2.0
PED	1.0

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Strategy III: Filler Composition and Manipulation

Tactics:

A. Develop filler materials that drastically alter combustion and pyrolysis properties and composition of smoke.

B. Design reconstituted tobacco compositionally so as to drastically alter the resulting smoke composition.

C. Develop capabilities to manipulate the inorganic composition of tobacco to control its burning characteristics.

D. Treat tobacco through pre and post-harvest methods to enhance flavor precursors and minimize "tar".

E. Use SCF extraction methods to transfer flavor, enhance flavor and remove non-flavorful tar contributors.

F. Close grown - Once over harvested tobacco - is it in the future?

G. Tobacco Processing - what next?

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Strategy IV: Cigarette Construction Research and Development
(How to Make a Cigarette)

A. Pursue "controlled" density cigarette to produce low density and variable density (center core, extruded) cigarettes.

B. Research and Development on the chemical and physical properties of cigarette wrapper and its effect on smoke.

C. How will cigarettes be manufactured in the year 2000?

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Strategy V: Filter Research and Development

Tactics:

A. Design filters for new cigarette rods, i.e. Low Density rods.

B. Evaluate effects of changing the physical and chemical properties of CA on smoke chemistry and subjective response.

C. Selectivity - what and how?

D. Filter materials - what and how?

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Strategy VI: Chemical Senses and Consumer Research

Tactics:

A. Using the brain response to chemical stimulus. Can we determine what is important to the smoker?

B. Understand what is acceptable to the consumer and why.

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PHILIP MORRIS PRODUCTS, INC.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .Mr. A. C. Lilly **Date:** November 8, 1988

From: .A. H. Confer

Subject: .THIRD QUARTER PLANNING MEETING

There were no changes to the International Product Development plans resulting from the last Planning Meeting.

Alan H. Confer

AHC:da

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PHILIP MORRIS PRODUCTS INC.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .Mr. A. C. Lilly **Date:** July 26, 1988

From: .A. H. Confer

Subject: .SECOND QUARTER PLANNING MEETING

We anticipate no major changes in plans for the International Products Program.

Alan H. Confer

cc: Mr. R. P. Heretick

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: A. C. Lilly **Date:** July 26, 1988

From: C. L. Irving

Subject: .UPDATED PLANS - INTERNATIONAL PRODUCT SUPPORT - JAPAN

Attached are the updated plans and testing schedules for product development/maintenance activities in Japan. The changes from the original plan are a reflection of the changes in program priorities due to the market turmoil in Japan.

Christopher L. Irving

Christopher L. Irving

CLI:da

Attachment

cc: R. P. Heretick
J. L. Myracle

2021555619

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

JAPAN PRODUCT DEVELOPMENT
OPERATIONAL PLANS
1988

Objective

To develop new cigarette products for the Japanese market which will contribute to our growth on this international market.

Status and Background

In cooperation with regional and New York management R&D has developed new products required to maintain a competitive advantage in the Japanese market. To facilitate the development of these products a strong understanding of the market is required. This understanding must include a knowledge of types of blends and flavor systems acceptable to the market and an understanding of the taste direction in which the market is moving. This information is obtained through consumer evaluations on cigarette models and interpretation of market sales and demographic data. The design of the models for these evaluations requires expertise from areas within R&D, such as, Flavor Development, Filter Development, and Product Development, as well as, areas outside of R&D, such as, Leaf, Engineering, and Technical Services. Final product selection is based not only on internal (Leaf & R&D) evaluation but also on evaluation of the product by consumers in Japan through Danchi Panel and PMI tests. Timing of these tests is critical to insure appropriate results are available prior to critical production and marketing decision points necessary for timely launch of the product. Completing these external consumer tests requires that internal model development and evaluation begin with a sufficient lead time to acquire any "unique" equipment and complete the design/develop/selection of flavors, blends, filters, etc. required. The amount of lead time required is therefore variable based on the unique features of the product. Our current contracts allow us to conduct one consumer test per month on Danchi I and one test every other month on Danchi II. PMI tests are conducted at the request of PMI marketing or where required to complete project objectives.

Strategies

1. Merit - Develop a product with full flavor response that beats Mild Seven in blind product testing but delivers only half the tar and/or as a second priority develop a product that beats Mild Seven Lights in blind product testing while delivering only half the tar.

2. Lark Optimization - Optimize the subjective acceptability of the Lark family while retaining the Lark character.

3. Lark 80 mm Box - Develop 80 mm Box versions of Lark and Lark Milds.

4. Starship - Develop products (L&M Milds, Chesterfield) that in conjunction with a young American image would compete successfully with the latest generation of U.S. imports.

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5. Virginia Slims Lights Menthol KS - Develop a KS version of Virginia Slims Lights Menthol with tar and menthol per puff deliveries equivalent to the 100's version.

6. Virginia Slims Lights 100's - Improve the subjective response of Virginia Slims Lights 100's FTB Japan.

7. Philip Morris Lights/Super Lights - Standardize the PM Lights family of products.

8. Marlboro - Develop a full flavor line extension of Marlboro Lights Japan.

9. Parliament - Develop a Parliament Lights product with a tar delivery below 10 mg in the KS and 100's format.

10. Lark Ultra - Develop an Ultra Lights line extension.

11. Merit Ultra - Develop an Ultra Lights line extension.

12 Philip Morris Ultra - Develop an Ultra Lights line extension.

13. Moment - Develop free standing 8 and 12 mg menthol products using a charcoal filter.

14. Nissan - Develop an acceptable value entry product proposition for the Japanese market.

15. Filter Development - Explore/develop unique filter concepts applicable to products for the Japanese market.

16. Product Maintenance - Maintain the consumer acceptability of PM products in Japan through routine product testing. The Lark family of products is given the highest priority.

Tactics - Product Development Life Cycle, Strategies 1-14

1. In cooperation with Leaf, Flavor Development, and with input from New York and regional management, Product Development reviews pertinent competitive product characteristics and market place data to determine the type of product required including general taste characteristics, blend style, flavor type, filter type and cigarette construction and the alternatives available to met these requirements. Based on these decisions the appropriate models are requested.

2. In cooperation with Engineering and Tobacco Processing and Fabrication any "special" equipment or components are obtained and the cigarette models produced.

3. Models are submitted for analytical and subjective evaluation.

4. Based on the results of subjective and analytical evaluations additional models are requested as required.

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5. Once successful candidates are produced additional samples are requested and produced for Danchi Panel testing.

6. Appropriate competitive products are ordered from the Japanese market for the Danchi Test. These samples are submitted for analytical and subjective evaluation to insure the product is typical. At this point, feedback is also sought from New York and regional management on the appropriateness of the products.

7. Products are made, ring tipped, packed, and shipped for consumer testing.

8. Products are tested in Japan and results are analyzed by PED. Based on these results, additional models may be requested, a product recommendation may be made, or a recommendation to conduct a PMI test may be given. The results from each of the consumer test adds to the information available for future decisions on the types of blends, flavors, etc., preferred in the marketplace.

9. Once the final product decision is made, product specifications are written and delivered to Operation Services.

10. Product Development, Flavor Development, and Leaf personnel cooperate with Operation Services to conduct a factory trial of the new product.

11. Product Development, Flavor Development, and Leaf personnel cooperate with Operation Services, Quality Assurance, Engineering, and Manufacturing personnel for the initial start-up and monitoring of the new product.

Tactic - Filter Development, Strategy 15

Conduct product trials with currently developed filter concepts. These include:

- Concentric filter with charcoal/CA center section
- Mixed black & white tow filter
- Paper w/charcoal
- Concentric filter w/recess
- Flush Fluted

2021555622

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

In cooperation with Filter Development and Engineering continue to pursue alternative filter concepts within PM and using outside resources. These concepts include:

o Plain paper filter	Filtrona
o Charcoal on a CA web	Celanese
o Coformed filter with charcoal	Kimberly-Clark
o Tube in tow filter with charcoal	
o FML filter with charcoal	

All of these filter concepts will be evaluated based on perceived subjective benefits, as well as, on the impact of the unique constructions on the analytical delivery of the cigarette (Tar, nicotine, filtration efficiency, gas phase, index, etc.). These results in conjunction with consumer feedback from concept and Danchi Tests will aid in the selection of filter construction designs for application on specific products.

Tactic - Product Maintenance, Strategy 16

In July 1988, the following blend philosophy was developed for Lark, L&M Milds and Chesterfield in Japan. This philosophy serves as the framework for the maintenance of these products.

- Maintain DBC Blend components consistent with US Marlboro through adjustments in the blend, flavors and cigarette construction.
- Move toward a single expanded tobacco component for Lark, L&M Milds and Chesterfield in Japan.
- Move toward a consistent ratio of RL 150B/RLTC for Lark, L&M Milds and Chesterfield in Japan.

To implement this philosophy a series of models for each product will be made for internal evaluation and based on those results consumer tests will be conducted as required.

Resource Allocation

Within Group

2 - Product Development Engineer
1 - Research Product Development Engineer

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Outside Resources Required

Semiworks
CI
Ops. Serv.
Eng.
Filt. Dev.
Flavor Dev.
PED

Samples Required

		Samples[3]	Cigts* Sample	Total Cigts.
Internal Evaluation[1]	=	180	4,000	720,000
PMI External Evaluation	=	18	66,000	1,188,000
Danchi 1 External Evaluation	=	36	15,000	540,000
Danchi 2 External Evaluation[2]	=	24	11,000	264,000
Market place models for PMI	=	18	66,000	1,188,000
Market place models for Danchi[1]	=	12	15,000	180,000
		288		4,080,000

* Good packed cigts. for shipment, does not include cigts. for CI, subjectives, etc.

[1] Assumes 3 "internal" models prior to Danchi Model 12 D1 x 3 int Models = 36

[2] No external models 6 D2 x 4 int Models = 24

[3] All of these samples will be submitted for CI analysis. This does not include samples for "Routine" Japanese CI.

Special Equipment Required

- Combiners
- Charcoal plug makers
- Extruders
- Paper filter makers (w/charcoal)
- concentric filter makers

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

INTERNATIONAL PRODUCT SUPPORT
JAPAN

Strategy	Resource[4] Allocation	Panel Tests[1] D1	D2	P	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	1st Qt.89
1. Merit	L	2	N	N							D1[5]			D1			
2. Lark Op.	L	N	N	3	P2	P											
Lark Maint.		Y	N	3			D1 P3										
3. Lark Box	L	N	N	N		*											
4. Starship	A	2	2	Y	D1 D2							D2	D1	P		*	
L&M Milds Maint.		Y	N	3				D1 P2		P							
5. VS-KS	R	N	N	N													*
6. VS-100's	R	N	N	N													
7. PML/SL	R,A	N	2	N				D2	D2								
8. Marl-FF	A	3	Y	6				P	D1	D2	D1 P4	D1 P		*			
Marl. Maint.	A	N	N	Y								P					
9. Parl. 100's	A	N	Y	N										D2			
10. Lark Ul.	L,A	N	N	N													*
11. Mer. Ul.	L,A	N	N	N													
12. PM Ul.	R,A	Y	Y	N							D1[5]		D2			*	
13. Moment	L,R	N	2	Y			D2								D2	P	
14. Nissan	R	N	N	N													
	Total	9	9	18													

[1] D1 - Danchi Panel 1, D2 = Danchi Panel 2, P = PMI Test, Y = Yes, N = No
[2] Concept Test
* Required Completion Date
[4] L = C. R. Lambert, R = D. L. Rockwell, A = C. B. Altizer
[5] One test includes prototypes for each product

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

1988 PMI TESTS	E #	SHIP DATE	CRITICAL ITEMS
Lark Milds OPT/Cabin Milds	8767	1/88	
Lark OPT/Cabin	8768	1/88	
Lark Milds/Lark Milds OPT	0840	2/26/88	
Lark Milds/Lark Milds ET-I	1941	3/18/88	
Lark Milds/Lark Milds ET-II	2033	3/18/88	
Lark/Lark ET-II	2034	3/31/88	
Marl US/Marl J	2452	4/7/88	Market Cigts., Factory Filler Marl US
L&M Milds/Viceroy Milds	2454	4/29/88	Market Cigts.
L&M Milds/Islands	2453	4/29/88	Market Cigts.
L&M Milds/HiLite Mild	3487	6/13/88	Market Cigts.
Marl J/Lark FF	3693	7/19/88	Market Cigts.
Marl US/Lark FF	3694	7/19/88	Lark from Market, Marl Factory Filler
Marl J-New/Lark FF	4651	7/19/88	JTI Filler
Marl US/Marl J-New	3695	July	JTI Filler
Marl J/Marl J-New	3486	August	Market Cigts. JTI Filler
Marl J/Lucky Strike		August	Market Cigts.
Chesterfield/Lucky Strike		October	Market Cigts.
Lark Milds ET-1/Lark Milds OPT			-
Lark Milds OPT/Cabin Milds			Market Cigts.
Marl J/Mild Seven			Market Cigts., Blasting
Marl US/Mild Seven			Blasting
Marl J-New/Mild Seven			JTI Filler, Blasting

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

1988 DANCHI I TESTS	E #	SHIP DATE	CRITICAL ITEMS	
Starship	6875	1/88	Starship - L&M Type	7/25/88
			Starship - Sweet Type	3 of 4
			Starship - Kent Type	CLI
			Kent Milds	
Lark	9912	3/11/88	Lark Milds Control	
			Lark Milds w/BLDET	
			Lark Milds w/BLDET & New DBC Burley & MT	
			Lark Milds w/LET & New DBC Burley & MT	
L&M Milds	0837	4/8/88	L&M Milds Control	
			L&M Milds w/Black Tow US Filter	
			L&M Milds w/White Tow US Filter	
			L&M Milds w/White Tow US Filter w/o Flavored PZ	
Marl	0040	5/26/88	Marl J-Market	
			Marl J	
			Marl J w/Charcoal Filter	
			Marl J w/Charcoal Filter & Marl Lts. Blend	
Light/Ultra	2948	7/8/88	Light/Ultra Model 1	
			Light/Ultra Model 2	
			Mount Ultra Model 1	
			Mount Ultra Model 2	
Marl *	2947	**7/28/88**	Marl J-Market	
			Marl J-New	
			Marl US	
			Lark FF	
Mild Seven	4672	**8/15/88**	Mild Seven - "Blasted"	
			Marl US ┐	
			Marl J-New ├ Made With White Tipping	
			Marl J-SW ┘	
Chesterfield		**September**	Mild Seven F-K	
			Chesterfield Model 1	
			Chesterfield Model 2	
			L&M Milds - White Tipping	

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old Type Represents Estimated Dates

*New Panelists must be recruited for the Danchi I Panel prior to this test.

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

1988 DANCHI II TESTS	E #	SHIP DATE	CRITICAL ITEMS
			7/25/88
Starship	7710	1/88	Starship - L&M Type Starship - Sweet Type Starship - Kent Type Lucky Strike
Moment - Test 1	1071	3/18/88	Mount - 7 mg tar, 0.10 mg Men Mount - 10 mg tar, 0.25 mg Men MB4 - 10 mg tar, 0.25 mg Men MB4 - 14 mg tar, 0.60 mg Men
PMSL - Low Side Stream	2664	4/8/88	PMSL Control PMSL w/ Magnesium Hydroxide Paper PMSL w/Calcium Carbonate Paper Flavored PMSL w/ Magnesium Hydroxide Paper
PMSL	2819	5/13/88	PMSL w/Alternate Tobacco Treatment PMSL w/Alternate Tobacco Treatment PMSL w/Alternate Tobacco Treatment PMSL - Control
Marl/Mild Seven	2818	6/16/88	Mild Seven - "Blasted" Mild Seven Lights Mild Seven Lights - "Blasted" Mild Seven King Size
Chesterfield	3988	8/5/88	Camel Milds Lucky Strike Chesterfield Model 1 Chesterfield Model 2
PM Ultra	3987	September	Frontier PM Ultra Model 1 PM Ultra Model 2 PM Ultra Model 3
Parliament		October	Parl 100's Control Parl 100's New Black TOW Parl 100's Milds Prototype Cosmos
Moment - Test II		November	Mount 10 mg Tar, 0.25 mg Menthol Mount 14 mg Tar, 0.60 mg Menthol MB4 14 mg Tar, 0.10 mg Menthol MB4 7 mg Tar, 0.60 mg Menthol

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

INTERNATIONAL PRODUCT DEVELOPMENT
OPERATIONAL PLANS
1988

Objective

To develop new cigarette products for international markets which will contribute to the growth of our international business.

Status and Background

Sales volumes for 1987 in the LA/I Region amounted to 95.6 billion units, an increase of 4.6 billion units (5.1%) over 1986. Our major efforts were directed toward Spain, Mexico, Venezuela, and Costa Rica with product development, product maintenance, and operations support projects.

For the EEC/EEMA Region, 1987 sales volume was 106.0 billion units. This volume is forecasted to grow at about 5% per year through 1989. Our collaboration with Neuchatel and Lausanne continued in 1987.

Excluding Japan, sales volume in the Asia/Pacific Region was 44.3 billion units, up 6.4% over 1986. Good growth was seen in all markets except Philippines (-10.8%) and Malaysia (-30.5%). We must clearly strengthen our efforts in Philippines and Malaysia in 1988. In addition, it is anticipated that the Korean market will be opened in 1988. This 80 billion unit market will afford us new growth opportunities.

Strategies

The three strategies outlined below will be pursued simultaneously in 1988. At the time of this writing, approximately 20% of our projects (i.e. tactics) support Strategy 1, 50% Strategy 2, and 30% Strategy 3.

1. Plan and execute product development projects of a proactive nature. These projects anticipate market needs, and can be initiated by R&D or PMI.

2. Plan and execute demand-driven product development projects. These projects respond to market needs, and are usually initiated by PMI.

3. Plan and execute projects of a "Product Maintenance/Operations Support" nature. Such projects are usually initiated by PMI.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Tactics/Timetable

Listed below are the tactics (projects) which we plan to use to achieve our three Strategies. The objective and target completion date is shown for each project. Detailed timetables for the projects are available from our Project Status Reports. (Timetables for the Strategy 3 projects are being developed.)

Strategy 1

1.	Project Avalon (Hong Kong, Singapore, Taiwan, Japan)	
	Provide prototypes for concept testing	4th Quarter, 1988
2.	Project Famous (Various Countries)	
	Optimize Chesterfield as a worldwide competitor to Camel	2nd Quarter, 1989
3.	Project Olympic (Korea)	
	Develop a product development program to penetrate the Korean market	4th Quarter 1988
4.	Project Tolstoy (Various Countries)	
	Develop an upscale Russian style cigarette	2nd Quarter, 1988

Strategy 2

1.	Project Country (Philippines)	
	Move the Philippine Marlboro closer to the US product	2nd Quarter, 1988
2.	Project Danny (Malaysia)	
	Increase the inclusion of local tobacco in the Malaysian Marlboro while attempting to maintain the taste quality of the product	2nd Quarter, 1988
3.	Project Dora/Manhattan (Hong Kong)	
	Develop an 11.5 mg KS product in both charcoal and non-charcoal versions.	April 1, 1988
4.	Project Premier (Philippines)	
	Develop PM Menthol Lights 100's at less than 15 mg tar	April, 1988

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

5. Project RFM (Singapore)

Develop a subjectively acceptable menthol product with a recessed filter	February 15, 1988

6. Project Speedboat (Hong Kong)

Develop an American blended KS product at approximately 9 mg tar	1st Quarter 1988

7. Project GB-1 (Costa Rica)

Develop a local brand as close as possible to Delta KS	March, 1988

8. Project LTN (Venezuela)

Develop a light cigarette at 12 mg tar	February, 1988

9. Project Nova (Venezuela)

Develop a 70 mm cigarette with a 23 mm circumference	February, 1988

10. Project V-87 (Panama)

Develop a product as close as possible to the Panamanian Viceroy	2nd Quarter, 1988

Strategy 3

1. CF Removal Program (Mexico)

   Remove CF from all brands produced by CIGATAM by using appropriate substitutes.

2. Flavor Compounding (Mexico)

   Assure a continuous supply of B&H flavor preblends to CIGATAM by compounding these preblends at flavor houses in Mexico.

3. Flavor Kitchen Upgrade (Philippines)

   Design an improved flavor kitchen with upgraded technology and safety features.

4. Panel Testing (Hong Kong)

   Provide requested prototypes for testing on the Hong Kong Panel.

5. Project ASTA (Spain)

   Design prototypes to evaluate the subjective acceptability of Spanish recon.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

6. Project Mas (Spain)

Develop a slim (23 mm circumference) 100 mm cigarette with brown tipping and cigarette papers.

Resource Allocations

The current staff of International Product Develop consists of:

Manager	
Associate Senior Product Engineer	1
Research Product Development Engineer	1
Product Development Engineer	3
	6

At the time of this writing, this staff is adequate to handle the workload. However, as Project Famous and Project Olympic get into high gear, more staff may be required. The anticipated opening of the Thailand market in 1989 will also increase the workload. For these reasons, it would be prudent to add one more staff member in 1988. An additional Product Development Engineer should suffice for now, with more addition(s) possibly needed in 1989.

Impact On Other Areas

Within R&D

CTSD (600 samples estimated)
Flavor Development Division
PED
TP&F Division (500 requests estimated)

Outside R&D

Leaf Department
Manufacturing Department
TTG
PMI Marketing Services
Affiliates/Licensees

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

JAPAN PRODUCT DEVELOPMENT
OPERATIONAL PLANS
1988

Objective

To develop new cigarette products for the Japanese market which will contribute to our growth on this international market.

Status and Background

In cooperation with regional and New York management R&D has developed new products required to maintain a competitive advantage in the Japanese market. To facilitate the development of these products a strong understanding of the market is required. This understanding must include a knowledge of types of blends and flavor systems acceptable to the market and an understanding of the taste direction in which the market is moving. This information is obtained through consumer evaluations on cigarette models and interpretation of market sales and demographic data. The design of the models for these evaluations requires expertise from areas within R&D, such as, Flavor Development, Filter Development, and Product Development, as well as, areas outside of R&D, such as, Leaf, Engineering, and Technical Services. Final product selection is based not only on internal (Leaf & R&D) evaluation but also on evaluation of the product by consumers in Japan through Danchi Panel and PMI tests. Timing of these tests is critical to insure appropriate results are available prior to critical production and marketing decision points necessary for timely launch of the product. Completing these external consumer tests requires that internal model development and evaluation begin with a sufficient lead time to acquire any "unique" equipment and complete the design/develop/selection of flavors, blends, filters, etc. required. The amount of lead time required is therefore variable based on the unique features of the product. Our current contracts allow us to conduct one consumer test per month on Danchi I and one test every other month on Danchi II. PMI tests are conducted at the request of PMI marketing or where required to complete project objectives.

Strategies

1. Merit Lights - Develop a 7 mg product with full flavor response.

2. Lark Optimization - Optimize the subjective acceptability of the Lark family while retaining the Lark character.

3. Lark 80 mm Box - Develop 80 mm Box versions of Lark and Lark Milds.

4. Starship - Develop products that in conjunction with a young American image would compete successfully with the latest generation of U.S. imports.

5. Virginia Slims Lights Menthol KS - Develop a KS version of Virginia Slims Lights Menthol with tar and menthol per puff deliveries equivalent to the 100's version.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

6. Virginia Slims Lights 100's - Improve the subjective response of Virginia Slims Lights 100's FTB Japan.

7. Philip Morris Lights/Super Lights - Standardize the PM Lights family of products.

8. Marlboro - Develop a full flavor line extension of Marlboro Lights Japan.

9. Parliament - Develop a Parliament Lights product with a tar delivery below 10 mg in the KS and 100's format.

10. Lark Ultra - Develop an Ultra Lights line extension.

11. Merit Ultra - Develop an Ultra Lights line extension.

12 Philip Morris Ultra - Develop an Ultra Lights line extension.

13. Moment - Develop free standing 8 and 12 mg menthol products using a charcoal filter.

14. Nissan - Develop an acceptable value entry product proposition for the Japanese market.

15. Filter Development - Explore/develop unique filter concepts applicable to products for the Japanese market.

Tactics - Product Development Life Cycle, Strategies 1-14

1. In cooperation with Leaf, Flavor Development, and with input from New York and regional management, Product Development reviews pertinent competitive product characteristics and market place data to determine the type of product required including general taste characteristics, blend style, flavor type, filter type and cigarette construction and the alternatives available to met these requirements. Based on these decisions the appropriate models are requested.

2. In cooperation with Engineering and Tobacco Processing and Fabrication any "special" equipment or components are obtained and the cigarette models produced.

3. Models are submitted for analytical and subjective evaluation.

4. Based on the results of subjective and analytical evaluations additional models are requested as required.

5. Once successful candidates are produced additional samples are requested and produced for Danchi Panel testing.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

6. Appropriate competitive products are ordered from the Japanese market for the Danchi Test. These samples are submitted for analytical and subjective evaluation to insure the product is typical. At this point, feedback is also sought from New York and regional management on the appropriateness of the products.

7. Products are made, ring tipped, packed, and shipped for consumer testing.

8. Products are tested in Japan and results are analyzed by PED. Based on these results, additional models may be requested, a product recommendation may be made, or a recommendation to conduct a PMI test may be given. The results from each of the consumer test adds to the information available for future decisions on the types of blends, flavors, etc., preferred in the marketplace.

9. Once the final product decision is made, product specifications are written and delivered to Operation Services.

10. Product Development, Flavor Development, and Leaf personnel cooperate with Operation Services to conduct a factory trial of the new product.

11. Product Development, Flavor Development, and Leaf personnel cooperate with Operation Services, Quality Assurance, Engineering, and Manufacturing personnel for the initial start-up and monitoring of the new product.

Timetable - Filter Development, Strategy 15

1. **January - March:** Conduct making/combining trials with currently developed filter concepts. These include:

    - o Concentric filter with charcoal/CA center section
    - o Mixed black & white tow filter
    - o Paper w/charcoal
    - o Concentric filter w/recess
    - o Flush Fluted

2. **April/May:** Prepare cigarette models from useable filters combinations and select those with greatest short term potential for concept testing in June.

3. **May:** Prepare models for PMI Concept Test.

4. **June/July:** Prepare cigarette models with a variety of filter constructions on tobacco rods suitable for Light/Ultra delivery cigarettes. Based on internal evaluation select prototypes for evaluation on Danchi Panels.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

5. **August**: Based on internal evaluations select and make models for Danchi Panel Tests.

6. **January - December**: In cooperation with Filter Development and Engineering continue to pursue alternative filter concepts within PM and using outside resources. These concepts include:

o	Plain paper filter	Filtrona
o	Charcoal on a CA web	Celanese
o	Coformed filter with charcoal	Kimberly-Clark
o	Tube in tow filter with charcoal	
o	FML filter with charcoal	

7. All of the filter concepts will be evaluated based on perceived subjective benefits, as well as, on the impact of the unique constructions on the analytical delivery of the cigarette (Tar, nicotine, filtration efficiency, gas phase, index, etc.). These results in conjunction with consumer feedback from concept and Danchi Tests will aid in the selection of filter construction designs for application on specific products.

Resource Allocation

Within Group

2 - Product Development Engineer
1 - Research Product Development Engineer

Outside Resources Required

Semiworks
CI
Ops. Serv.
Eng.
Filt. Dev.
Flavor Dev.
PED

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Samples Required

		Samples[3]	Cigts* Sample	Total Cigts.
Internal Evaluation[1]	=	180	4,000	720,000
PMI External Evaluation	=	13	66,000	858,000
Danchi 1 External Evaluation	=	36	15,000	540,000
Danchi 2 External Evaluation[2]	=	24	11,000	264,000
Market place models for PMI	=	13	66,000	858,000
Market place models for Danchi[1]	=	12	15,000	180,000
		278		3,420,000

* Good packed cigts. for shipment, does not include cigts. for CI, subjectives, etc.

[1] Assumes 3 "internal" models prior to Danchi Model 12 D1 x 3 int Models = 36

[2] No external models 6 D2 x 4 int Models = 24

[3] All of these samples will be submitted for CI analysis. This does not include samples for "Routine" Japanese CI.

Special Equipment Required

- Combiners
- Charcoal plug makers
- Extruders
- Paper filter makers (w/charcoal)
- concentric filter makers

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

INTERNATIONAL PRODUCT SUPPORT
JAPAN

1/15/88

Strategy	Resource[4] Allocation	Panel Hts[1] D1	D2	P	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	1st Qt.89
1. Merit	L	N	N	2		P2											
2. Lark Op.	L	N	N	2	P2		*										*
3. Lark Box	L	N	N	N		*											
4. Starship	A	Y	Y	Y	D1 D2		I										
5. VS-KS	R	Y	N	N					D1		*						
6. VS-100's	R	N	N	N													
7. PML/SL	R,A	2	N	Y			E1	D1		P			*				
8. Marl-PF	A	Y	N	Y		DI		P					*				
9. Parl.	A	Y	N	N						D1			*				
10. Lark Ul.	L,A	Y	N	Y									D1		P		*
11. Mer. Ul.	L,A	Y	N	Y								D1		P			*
12. PM Ul.	R,A	Y	N	Y							D1		P				*
13. Moment	L,R	Y	3	Y			D?		D2		D2			D1		P	*
14. Nissan	R	Y	N	Y											D1	P	*
15. Fil Dev	A	Y	2	Y						P[2]			D2		D2	D1	
	Total	12	6	3													

[1] D1 - Danchi Panel 1, 2 = Danchi Pnel 2, P = PMI Test, ' = Yes, N = No
[2] Concept Test
* Required Completion Date
[4] L = C. R. Lambert, R = D. L. Rockwl, A = C. B. Altizer

MAR 01 '88 15:21 PM R&D

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: Cliff Lilly **Date:** Nov. 17, 1988

From: Chris Campbell

Subject: SUMMARY OF FILTER RESEARCH AND DEVELOPMENT PRESENTATION AT SEPTEMBER 28, 1988 PLANNING CONFERENCE

The overall goal of the Filter Research and Development Project is: "To develop filter systems which will achieve performance advantages for our products".

Three major program strategies are being pursued:

1. Develop improved filtration systems.

Increased filtration efficiency systems are being investigated which result in better smoke removal at an equal pressure drop. These include Cellulose Acetate Web from Celanese, paper filters, Eastman low denier tow, and very low denier polypropylene tows. Use of an improved efficiency filter could result in a subjective advantage at the same delivery, or equivalent subjective response at lower delivery.

Improvement of menthol stability over time will result in products which deliver desired levels of menthol regardless of age after manufacture. Planned testing to accomplish this includes Filtrona heat set filters, PVA menthol formulation improvements, and pre-application of menthol to tow prior to rod formation.

Selective filtration of smoke components by use of specific additives in the filter are expected to change the subjective response or help meet particular delivery targets. Testing is underway with additives which will change the subjective character of FML filters. Also, additives which preferentially reduce nicotine delivery are being identified for possible use on GCC Marlboro where nicotine delivery is regulated.

2. Model the effects of filter designs on cigarette performance.

Mathematical models of Low Density and ART tobacco rods have been developed which predict pressure drop and delivery as functions of rod design, puff position and puff volume. These are available in a software package for design assistance.

Models to predict the performance of paper filters, CA web filters, low denier tows, concentric filters, tube-in-tow filters and lowered mass burn rate products are in the process of being developed. An expert system for accessing these programs is scheduled to be installed for use by the Filter R&D Group.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

3. Provide filter support for major R&D programs.

Filter samples will be provided for analytical and subjective evaluation on various major R&D programs such as ART, High Taste / Low Tar, Low Density Rod, and Project Tomorrow.

2021555641

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CONFIDENTIAL

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .A. C. Lilly **Date:** August 1, 1988

From: .P. N. Gauvin

Subject: .Review of Filter Research and Development Program from the Planning Conference, June 29-30, 1988

The objective of the Filter Research and Development Program still is to identify the fundamental requirements and recommend specifications for filter systems required on new or specialized products (i.e., Delta, Low Density Rod, ART, Low Tar/High Taste). This program is a cooperative effort with Physical Research in reviewing previous filter data and expanding upon this data base. It also includes the development of alternate filter systems to CA tow and additives to filter systems for subjective/analytical advantages. Under this program our working relationships with our suppliers are being redefined to possibly increase our future exclusivity opportunities.

Final approval for the initial staffing of this program has been received and personnel are in place. As of July, 1988 this program is active and initial status of various program efforts will be reviewed at the 3rd Quarter 1988 Planning Session.

Paul Gauvin

P. N. Gauvin

PNG/sbb

cc: J. Myracle

2021555642

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Operational Plan

For The Filter Research

And Development Program

1988

2021555643

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

OPERATIONAL PLAN FOR FILTRATION RESEARCH AND DEVELOPMENT

OBJECTIVE:

(1) Design cigarettes to give tailored delivery profiles for both the particulate and condensible vapor phases of TPM for potential subjective advantage.

(2) Evaluate new filter concepts as generated within and outside of R&D to determine product advantages in the marketplace.

STATUS:

In order to exert maximum control over our products, we need to be able to tailor the puff-by-puff delivery profiles of cigarettes to meet subjectively favorable targets. Additionally, we need to design filter systems to best complement new product concepts. There are a number of filter materials from which to choose and many possibilities for combined filter designs. It is a goal of this program to provide the basis for making such choices in order to achieve target delivery profiles of both the particulate and condensible vapor fractions of tobacco smoke.

An additional goal of this program is to develop and evaluate new filter concepts to determine their market potential. These concepts are aimed at both the Domestic and International markets and are designed to support the current business plus give smokers a product advantage. Currently under development is the optional smoking filter cigarette which allows normal smoking or smoker satisfaction where normal smoking is not allowed. Additional filter concepts under development include a modified fluted plastic filter, PVA menthol for menthol release upon demand from the filter, concentric filters, tube-in-tow filters and CA web filters.

Finally, the effect of filter additives such as citric and lactic acids are under evaluation for tar/nicotine control and subjective modification of the smoke. Initial observations indicate that acidic additives can produce a milder/cleaner tasting cigarette with enhanced bright tobacco-like smoke character. Basic filter additions tend to increase the harshness, throat impact and dark notes in smoke. The application of filter additives to menthol cigarettes plus the effect of additives to the tipping paper are also being investigated.

STRATEGY I:

Develop a data base and computer-based models for predicting particulate/vapor TPM profiles as functions of cigarette design.

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TACTICS AND TIMETABLE:

(A) Characterize and model the TPM deliveries of unfiltered tobacco rods as functions of puff position and puff volume; determine the effects of tobacco rod density and circumference on delivery. This will be accomplished by the third quarter of 1988.

(B) Characterize and model the effects of conventional cellulose acetate filters on the TPM delivery profiles of a standard tobacco column as functions of puff position and volume; determine the effects of tow specifications, pressure drop, filter length, and filter circumference on delivery. An experimental program has been designed for Tennessee Eastman to collect the appropriate data for this study. This will be accomplished by the fourth quarter of 1988.

(C) Characterize and model the effects of paper, CA web, polypropylene, and charcoal-on-tow filters on the TPM delivery profiles of a standard tobacco column as functions of puff position and volume; determine the effects of filter design specifications on the delivery profiles. An experimental program has been designed for Celanese to collect the appropriate data for this study. This will be accomplished by the fourth quarter of 1988.

(D) Model the effects of hollow tubes, impactor stages, concentric CA filters, tube-in-tow dual filters, and any combination of filter sections on TPM delivery profiles. This will be performed on an as-needed basis. Currently we are using models to mimic the behavior of tube-in-tow dual filter products, concentric CA filters, and have designed a program for Celanese to evaluate tube-in-tow filters.

(E) Develop a computer-based tool for predicting the delivery profiles of cigarettes based on their designs. The first benchmark goal is a design system for the Physical Research Division; the first prototype should be completed in the second quarter of 1988. The second benchmark is an extremely "user-friendly" system designed for development work in Product Development and Operations Services; this will be available during the fourth quarter of 1988.

(F) Develop mathematical models of the effects of design on cigarette performance using the data in the domestic and international CI data bases and the TLA data base. This work will be performed on an on-going basis.

(G) Test models and concepts by designing novel products and the appropriate controls for consumer analytical testing. This will be carried out on a continuing basis.

(H) Provide cigarette design support for other R&D programs, including Project Tomorrow, Project Art, and the Delta Program.

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RESOURCE ALLOCATIONS:

Physical Research - modelling, design, and data analysis (4.0 p.y.)

Semi-Works - producing models for evaluation (0.10 p.y.)

Cigarette Testing Services - physical and delivery testing (0.25 p.y.)

Computer Applications - program support (0.8 p.y.)

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STRATEGY II:

Develop alternate filter materials to CA and charcoal or alternate forms of CA for improved filtration and subjective characteristics.

TACTICS AND TIMETABLE:

(A) FML Filter

- Complete current consumer testing - January, 1988
- Define brand category and consumer test - March, 1988
- Quantify smoke chemistry changes with additives - March, 1988
- Demonstrate wax applications at KDF-2 Speeds - June, 1988

(B) CA Web Filter

- Evaluate Celanese CA web filters as available
- Support sample fabrication of CA web filters, if warranted, and evaluate - 1st Half, 1988

(C) Determine Alternate Materials To Charcoal For Improved Subjective Response - 2nd Half, 1988

STRATEGY III:

Develop filter concepts to achieve a marketing advantage through a unique flavor presentation.

TACTICS AND TIMETABLE:

(A) PVA Menthol Filter Concept

- Complete aging studies on optimum formulations - May, 1988
- Initiate consumer testing of PVA Menthol concept - June, 1988
- Transfer process specs to Domestic Product Development for implementation - Sept., 1988

(B) Concentric Filters

- Evaluate black core concentric filters with carbon - February, 1988

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- Evaluate PVA Menthol applied to concentric filters - March, 1988

- Consumer test PVA Menthol on concentric filters - June, 1988

(C) Optional Smoking Cigarette

- Improve the subjective response of the menthol optional smoking device - 1st Half, 1988

- Initiate additional consumer testing - 2nd Half, 1988

(D) Tube-In-Tow Filter

- Fabricate acceptable samples to demonstrate concept - February, 1988

- Complete internal subjective testing - March, 1988

- Complete consumer testing - June, 1988

(E) Modified Fluted Plastic Filter

- Demonstrate time pattern hot melt application - January, 1988

- Improve tipping efficiency and transfer technology to PM Engineering for E.E.M.A. Region - March, 1988

RESOURCE ALLOCATION (STRATEGIES II - III)*:

Current Cigarette Technology personnel assigned:

	Man/Yrs.
Associate Senior Engineer	0.5**
Research Engineer	1.0***
Research Engineer	0.6**
Associate Engineer A	1.0
T-5 Technician	0.5**
T-3 Technician	1.0
Temporary (FML Program)	1.0

*Includes development resource allocated to Strategy I
**Impacted by Delta
***0.75 Man/Yrs. assigned to menthol-on-foil

REQUIRED DURING 1988:

As a result of the impact of Delta an additional Mechanical Engineer and a Technician with mechanical experience are needed in the development portion of this program to meet 1988 objectives. In addition, as this program evolves during 1988 other staffing requirements may be needed.

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OTHER AREAS IMPACTED:

Product Development
Flavor Development
PED
Semi-Works
Cigarette Testing
Manufacturing
Manufacturing Services
Analytical
Physical Research
Purchasing
International

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STRATEGY IV:

Determine the effects of filter additives on the analytical and subjective character of cigarette smoke.

Utilize filter additives to control smoke deliveries and enhance the subjective character of cigarettes.

TACTICS AND TIMETABLE:

(A) Filter Additives For Tar/Nicotine Control

- Determine effect of various levels of citric acid in the filter upon analytical/ subjective deliveries - 1st Qtr., 1988

- Determine the effect of filter ventilation on tar/nicotine control with varying levels of citric acid in the filter - 1st Qtr., 1988

- Identify filter systems that affect the nicotine/tar ratio in conventional and Art cigarettes - 2nd Qtr., 1988

(B) Filter Additives For Subjective Modification

- Characterize mentholated and non-mentholated models with low levels of citric and lactic acids - 2nd Qtr., 1988

- Evaluate the subjective effects of various additives on tippings - 2nd Qtr., 1988

- Evaluate the effects of acid salts on citric and phosphoric acids on cigarette smoke - 3rd Qtr., 1988

- Apply various additives to other types of filters, e.g. FML, paper to modify their subjective character - Continuing Thru 1988

- Identify filter systems for low tar products - 3rd Qtr., 1988

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RESOURCE ALLOCATION

Current Flavor Development personnel assigned:

	Man/Yrs.
Associate Principal Scientist	0.25
Scientist	1.0

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .A. Cliff Lilly Date: November 11, 1988

From: .R. N. Ferguson

Subject: .Update on Plans for Reduced Sidestream Program

Some modifications to the program priorities described in the plan update issued August 9 were indicated as a result of discussions at the 3rd Quarter Planning Conference. This should be considered only as some modifications of plans, not a replacement for the August 9 update.

Models for Reduced Sidestream

Planned efforts on filler modification, core periphery studies, rod density, salt effects and other non-wrapper related sidestream control efforts have been reduced.

Planned efforts on cigarette paper modification in order to reduce sidestream have been increased. Emphasis on novel technology - such as sol-gel methods - and novel materials have enlarged due to several factors. The following examples illustrate the type of priorities being pursued and those to be initiated in the 1st Q, 1989.

. More extensive interaction with Dr. W. Fink and the research staff at FTR will be initiated with the objective of sharing information on paper properties and performance.

. More active involvement with Dr. Kallianos in-house studies on the sol-gel process has been initiated.

. Contact has been established with the sol-gel research program of Dr. Don Schleich at N.Y. Polytechnic and complimentary research studies will be planned for Chemical Research.

. A position has been made available for a synthetic inorganic chemist to support several needs identified within the department, among them several in support of sidestream reduction.

. The planned effort at the University of Maine has been expanded. A dual headbox system is being constructed. The contact person there, Dr. David Kraske, has been informed that we will also be expanding the support services we will need them to provide. Plans are being made to use this facility to scale up any paper process made using a sol-gel approach to paper modification.

. A coater has been added to the hand sheet facility at R&D. A Coresta porosity instrument is on order for this lab.

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. Plans to evaluate a wider range of inorganic fillers have been made, to provide support for other R&D needs. A BET surface area measurement system has been ordered to support this research.

. Suggestions from Dr. C. Mattina (consultant) and Dr. Kallianos are being used to develop plans to investigate fluxing agents with improved performance.

. Dual wrap cigarettes can demonstrate major sidestream reductions. Efforts to interpret this effect and its impact on smoke chemistry are underway.

. Effort will be initiated to prepare single wraps with dual wrap properties.

. Tobacco identical materials, tobacco salts, tobacco extracts and fractions will be evaluated in single or double wrap configurations. Evaluation of possible subjective improvements will be a significant component of this effort.

. Suggestions at the planning conference to evaluate fibers other than flax are being pursued. Several fiber samples are now available.

. A project to lumen load fibers with inorganics will be funded in early 1989. The work will be done at the U. of Washington.

. Plans have been made to evaluate chemical modification of fibers to improve physical properties or smoke chemistry. These cannot be initiated until mid 1989.

Methods For Evaluation of Sidestream

A major effort is also continuing to develop and improve methods to evaluate sidestream chemistry and visibility. Only some selected examples of significant areas of priority and activity are cited below.

A. Visibility

The 8 port system will be made operational. Research will then be discontinued with the 5 and 17 port systems. The single port system is still required to support handsheet studies and its use will continue.

B. Sidestream Chamber

Approval has been received for this project and several components have now been ordered. Component evaluation and assembly will be a major commitment for 1989.

C. Odor

The E-2 conference room sidestream odor evaluation study has been completed and documented. No further work is planned in this area.

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One other area of alteration in plans should be cited. There is continuing interest in a better execution of the swept device as a new flavor delivery system with no sidestream or CO. A better device will require research on delivery methods and on materials appropriate for use. Research on concepts for such a system is planned for 1989. This research will be evaluated as it progresses and either increased or terminated depending on its progress.

Please refer to the update of August 9 for an overview of other aspects of the programs, such as irritants in smoke, Coresta studies, or resource allocations.

/ds

cc: J. Charles
P. Gauvin

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .A. C. Lilly Date: August 1, 1988

From: .P. N. Gauvin

Subject: .Review of Product Studio (Regular Circumference Low Sidestream Products) From the Planning Session, June 29-30, 1988

This review of the development of low sidestream products addressed developing regular circumference products only. The current status of flavor low and full flavor products with 12% Mg $(OH)_2$ paper to achieve 55-60% sidestream visibility reduction was reviewed. Consumer testing of these products versus Cambridge Lights and Cambridge Full Flavor is planned for the 4th Quarter, 1988.

The use of cigarette paper with reduced levels of Mg $(OH)_2$, 7%, are being evaluated, primarily as a possible application to a Trim cigarette. The use of high levels of Mg $(OH)_2$, 35%, in cigarette paper continues to be developed but subjective problems have yet to be overcome. A new method of precipitating the Mg $(OH)_2$ in the paper-making process by Ecusta may help to overcome these subjective problems.

A review of the special $CaCO_3$ from Kimberly-Clark indicated that this paper is currently being evaluated on a potential Trim product. Efforts are underway to minimize chimney and streaking effects and optimize subjectives. Further work will be done with this paper on larger circumference products.

At this time considerable effort is being given to Chemical Research with regards to material and personnel support in their efforts to develop new methods for reducing sidestream.

Plans for the 3rd Quarter include consumer testing of low sidestream products with 12% Mg $(OH)_2$ paper. We will continue to evaluate modified Mg $(OH)_2$ papers from Ecusta and special $CaCO_3$ papers from Kimberly-Clark. We will also expand our efforts with suppliers to optimize these special papers from a low sidestream and subjective standpoint.

Paul Gauvin

P. N. Gauvin

PNG/sbb

cc: J. Myracle

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .Cliff Lilly Date: August 9, 1988

From: .Bob Ferguson

Subject: .Update on Plans for the Reduced Sidestream Program

I. Program Objectives

The objective of the program encompasses both research and development activities which will lead to products with reduced sidestream smoke. An important aspect of the program is an emphasis on developing sidestream reduction methods which are proprietary to Philip Morris. The formal statement of the objectives and target dates remain as stated below:

- Conduct research leading to reductions in three sidestream parameters visibility, irritation, and odor. Develop technologies to reduce each of these by 1990.
- Develop cigarette models with 50% reduction of sidestream and evaluate these by 1990.
- Integrate these technologies into ongoing Development programs to produce improved products by end of 1991.

II. Background and Status

The first half of 1988 has seen an increased shift of activities toward research into methods for analysis of a sidestream components and development of in-house capabilities for wrapper modification. Considerable attention was also devoted to interactions with Kimberly Clark (high surface area $CaCO_3$ papers) and Ecusta $(MgOH)_2$ wrappers with improved subjectives). Progress in this area was driven by the need to provide a reduced sidestream wrapper for the "Trim" cigarette. This intensive R&D effort has produced significant subjective gains over early models and provides a basis for additional refinements even if product targets should be altered.

Research activities have encompassed both method development and model preparation and evaluation.

Visibility

A visibility system was designed and built around a 5-port smoking machine to provide an alternative to either the single or 17-port systems. An 8-port smoking machine was also acquired for future studies.

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A CORESTA study of SS TPM was incorporated into this program as a reference method.

Subjective evaluations of visibility of reduced sidestream cigarettes by panelists were conducted with encouraging results.

Irritants

Ammonia analysis method was completed and model cigarettes were evaluated.

Two methods were developed for aldehydes and a study of glycerine as a precursor of acrolein was completed.

A gc method for benzene and toluene in SS was developed.

GC/MS profile studies continued on gas phase, particulate matter and a headspace sampler was added to the system capabilities.

A possible contract facility for bioassay of irritants was identified.

Odor

A sidestream odor panel was established using E2 conference room and began evaluating samples on a daily basis.

Cigarette butt odor studies progressed to larger scale efforts.

Sidestream Chamber

Design and specifications were completed for a smoke chamber and associated equipment. These were incorporated into a capital appropriation request which has been approved by R&D management.

Models

Strategy sessions were held to develop tactics for smoke reduction methods which resulted in an emphasis on certain paper and construction parameters.

Mr. Bob Rogers, along with Dr. Bokelman's group, have begun to establish a wrapper preparation capability for R&D. A hand sheet lab is under construction. The U. of Maine was selected for contract pilot scale paper preparation.

Efforts were initiated to take advantage of core-periphery differences and blend component differences for sidestream formation.

III. Plans

Emphasis for the remainder of 1988 has shifted to the development and evaluation of models. Based on discussions with suppliers and studies at R&D, several promising strategies have emerged for visibility reduction. Some involve wrappers, others are based on aspects of

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construction. The listed tactics below each strategy will be initiated in the 3rd and 4th Q 1988 but few, if any, will be completed this year.

Strategies - Reduced Sidestream

A. Reduced porosity of wrapper - there are several different modes to accomplish this objective. The goal is to evaluate the relative importance of this parameter. Furthermore, the intent is to determine the relative contribution of various methods by which paper porosity can be reduced.

Studies in this area will include:

Effects of film forming agents, including thermoplastic materials.
Refining effects on fibers.
Lumen loading of fibers with inorganics.
Effect of different fillers used to achieve the same permeability.

B. Physical-chemical nature of paper fillers

This study will be in cooperation with the Technology Assessment group and Dr. Kallianos. Studies will include:

Evaluation of alternative inorganics, including minerals, to provide a chemically different condensation surface.
Evaluation of new technology to provide a high surface ceramic after heating.
Evaluation of possible importance of mechanisms such as dehydration, altered crystal morphology and large increases in surface area of the inorganic component of the wrapper.

C. Improved paper technology

One example in this area is the use of dual headboxes to prepare inner and outer papers. The inner paper can contain materials such as carbon to produce unique composite structures.

D. Aspects of Cigarette Construction

Reduced tobacco in rod - Reduced circumference, reduced rod density

Altered blend composition - Evaluation of blend components core versus periphery effects

Altered burn characteristics - Evaluate effect of added burn agents

Strategy - Mechanism Studies

Additional evaluation of possible mechanisms for sidestream reduction will provide the benefit of setting clearer priorities for future product development. For this reason some studies are planned in this area.

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KC and Ecusta will be requested to supply us with papers which can be used for these studies. ^{14}C-labelled tobacco studies are also being planned to provide insight into this area. These will not require additional KC or Ecusta support.

Strategies - Visibility, Irritation and Odor

Improved understanding of these aspects of sidestream smoke will remain important program strategies.

A. Visibility

The 5-port machine will be made fully operational and put into routine use.

Development of alternative modes for visibility studies will continue. These include image analysis methods and light reflectance measurement.

Reduced circumference, permeability effects and other model systems will continue to be evaluated using the visibility measurement systems.

The subjective evaluation of smoke visibility by panelists will be enlarged to provide a basis for future product evaluation and establish a basis for claimed visibility reductions.

B. Irritation

The gc/ms studies will continue. New collection techniques will be evaluated. Additional capabilities for data storage and retrieval will be implemented.

Ammonia in Cigarette Smoke

Measure the SS and MS ammonia deliveries of 100% blend component cigarettes

Analytical support to the SS chamber

Aldehydes in Cigarette Smoke

Measure the MS and SS aldehyde deliveries of 100% blend component cigarettes

Study the contribution of glycerine to the MS and SS aldehydes

Provide analytical support to Trim, and the SS chamber

Benzene and Toluene in Cigarette Smoke

Complete this work on the $Mg(OH)_2$ cigarettes

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Use the method developed for benzene and toluene to study other MS and SS components

Study the effect of heating on the collection efficiency of Cambridge Filters

Provide Analytical support to Trim and the SS chamber

Contract negotiations for bioassay development for irritants will be completed.

C. Odor

The panel will provide a recommendation for any future product development using materials it has evaluated by the end of 1988.

Efforts will continue to identify the compounds responsible for butt aroma. Analytical studies will depend on progress with subjective identification.

Strategy - Sidestream Chamber

Upon appropriate authorization, the remainder of this year will be required for chamber construction.

IV. Resource Allocation

The challenge for this program for the remainder of 1988 will be to develop and demonstrate models for reduced visibility. Subjective considerations are not critical until this minimum requirement has been met. For this reason, increased emphasis will be placed on certain areas:

Hand sheet and pilot paper facility
Alternative filler candidates
New technology for paper additives
Novel wrapper techniques
Define relative contribution of blend & construction to reduced visibility
Develop a better understanding of the mechanisms controlling the contribution of the wrapper to reduced visibility

The attached table highlights some areas where R&D groups are directly influencing the progress of the program. In addition to those listed below, most other R&D functions are supporting this effort to some extent. The total manpower commitment estimate at the 2nd quarter planning conference was 31.0 man years (professional and technicians) for sidestream control.

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STRATEGY AREAS

	MODELS FOR REDUCED SS	MECHANISM STUDIES	VISIBILITY	IRRITATION	ODOR	SIDESTREAM CHAMBER
CHEMICAL RESEARCH	3.1	1.5	2.5	2.0	2.0	1.5
ANALYTICAL RESEARCH		0.5		3.0	.5	
CIGARETTE TECHNOLOGY	1.5		1.0			
PRODUCT EVALUATION			1.0		1.0	
TOBACCO MATERIALS	1.0					
TECHNOLOGY ASSESSMENT	0.5					

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: Date: May 13, 1988

From: .R. N. Ferguson

Subject: .Update on Status and Plans for the Reduced Sidestream Program

This program's goal is to develop proprietary products with reduced sidestream smoke. An secondary, near term objective is to support the development of products with reduced smoke visibility utilizing papers being developed by outside suppliers. This update will focus on the longer term, proprietary technology goal.

The goal of reduced sidestream is understood to mean reducing the perception of sidestream (SS) smoke by our customers or by non-smokers. Individuals perceive aspects of smoke such as visibility, odor, and irritation as possible negatives. We thus are developing methods to modify each of these parameters and methods to measure the extent of modification. Because of the scope of the issues involved, we are utilizing resources from several Divisions although the largest personnel commitment remains within Chemical Research.

A status update is warranted at this time because several changes have occurred in program plans and organization since the last operational plan update of February 29. These changes follow from a recognition that models need to be constructed and examined with significant changes in wrappers, blend components, construction parameters, or other cigarette parameters in order to effect large reductions in sidestream. These significant changes reduce the probability that any one prototype will successfully proceed to a product. Therefore I am recommending that several alternative approaches receive an initial evaluation before focusing on one most promising alternative for further product development.

Based on input from the R&D staff proprietary paper technology remains an important and viable option for sidestream reduction. Since it is important to make effective use of this technology as soon as possible, several actions have been taken:

1. A hand sheet facility will be established in the former CSTR lab, with Mr. Bob Rogers supervising its operation.

2. Sites are being evaluated to prepare larger quantities of paper for machine made cigarette preparation.

3. Gordon Bokelman's project has been given a research support role for paper technology.

4. Barbro Goodman's Smoke Studies project has been placed in a "dotted line" relationship to Chemical Research.

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5. Research resources outside of R&D with applicable expertise have been located.

6. Other wrapper concepts have been discussed and some studies are now in progress.

Based on these activities, handsheets could be produced off site in the next few weeks and at R&D before the end of the year.

A second major area to be investigated relates to the quantity of tobacco in the rod and the blend components. The objective is to produce less aerosol so that there is less total smoke available for either SS or MS. Peter Martin will make available cigarettes with reduced rod density for SS research studies. Blend extenders such as carbonized stem will also be evaluated as part of this aspect of the program. The contribution of various blend components and additives to sidestream will be examined as part of this effort. The radiochemistry capabilities available within Chemical Research can make an important contribution to this aspect of a new product.

The third area being investigated could generally be described as construction parameters. For example, research at R&D has demonstrated significant differences in the core and periphery contributions to sidestream smoke. These effects might simultaneously enhance mainstream subjectives and improve sidestream. Core/periphery effects to be evaluated include:

Blend differences (composition)
Density differences (including chimney effect)
Additive differences (burn chemistry)
Combined effects

There are opportunities for proprietary products with reduced sidestream using all three of the above approaches. Several senior staff members have been selected to guide programs in the construction of these prototypes. However, some additional support staff may be needed to prepare components and will be needed to hand construct prototypes.

As stated before, these prototypes will be evaluated not only for visibility but by other criteria. The status of methods development and research in this area is thus important to the evaluation of each candidate cigarette. Each of the three major sidestream target areas will be updated.

Visibility

A study has been designed to compare the visibility measurement equipment at the OC and the 17 port machine. Modification of both the machines for ease of operation is also scheduled. Data have been obtained on a set of cigarettes from the Coresta study for sidestream TPM. These will also be used for visibility. It is our goal to be able to measure visibility in either the static or smoking mode and to be able to compare this to sidestream TPM in either mode. Also, all cigarettes will be compared to a standard cigarette for visibility studies. If needed, an appropriate reference cigarette will also be added to provide a second

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number, visibility reduction versus the reference. This parameter will be useful for Development studies.

Odor

A panel has now been established and is regularly meeting to evaluate parameters such as sidestream odor modification and reduction in sidestream aroma. Dr. Southwick has selected twelve compounds for more detailed subjective evaluation by this panel. Also, together with Analytical Research, further studies of the smoke components responsible for the odor of stale cigarette butts are progressing. Identification of these compounds may lead to methods to reduce their formation during smoking. Finally, the library of sidestream smoke components is being enlarged and many of the more interesting candidates are in use for odor profile studies. The information gathered by each of these studies will be applicable to whatever route to a propriety product is ultimately pursued.

Irritation

This aspect of sidestream is also being studied on several fronts. Analytical Research has established a project to quantitate certain irritants reported present in sidestream. This group is currently developing plans to extend its capability to include additional smoke components and methods. This project will also be able to interface its expertise to the sidestream smoke chamber to be constructed on T-7. Combined gc/ms methods are in use to survey sidestream gas phase and particulates for compositional changes produced by products with reduced sidestream. The possibility of a biological assay endpoint for irritants has not been ignored as part of this program. Research to develop this method would likely be conducted at an outside research center and is under consideration at present.

In summary, these updated plans address the challenge to consider significant modifications of current products in order to alter the production, distribution, and composition of smoke. The proprietary technology to be developed offers advantages for this and other R&D programs. It must be understood that the scope and complexity of these issues go beyond visibility modification. This effort will compliment product development efforts with commercially available papers, but needs different research support, staffing, and time scale for completion. In this update, I have chosen not to address subjective issues or other considerations which will become increasingly important as these studies progress. That subject would be more appropriate at a future point when sidestream reduction issues have first been addressed.

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Summary of Strategies and Tactics

I. Proprietary Methods for Reduction of Sidestream

1. Wrapper	
Hand sheet production - outside R&D	3rd Q
- at R&D	4th Q
Pilot scale production	4th Q
Research on improved papers	
- Conventional components and technology	ongoing
- new materials/technology	
2. Blend - qualitative and quantitative changes	
Reduced density rod evaluation	3rd Q
Modification of blend to reduce sidestream	
- components	ongoing
- processing/treatment	
3. Construction	
Core/Periphery studies	
Composition	6/88-6/89
Density	
Additives	
Combined effects	

II. Evaluation of Reduced Sidestream and Reduction Mechanisms

1. Visibility	
Uniform measurement criteria/method	ongoing
Coresta Study of Sidestream	June
Visibility comparison to TPM	July
Ultrastructure studies-relation to visibility	ongoing
2. Odor	
Sidestream odor modification-decision point	July
Sidestream odor reduction	3rd Q
Cigarette butt aroma components	4th Q
control	1989
Sidestream component library	ongoing
Odor profile - components and fractions	ongoing
Odor studies using chamber	1989
3. Irritation	
Analytical methods - development	3rd Q
application	ongoing
Construction of ETS chamber	3rd-4th Q
Methods for ETS chamber	4th Q
Survey of SS fractions and composition	ongoing
Bioassay for irritants	proposed to be reviewed

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4. Mechanisms for Sidestream Reduction

Radiochemical studies - Smoke formation and MS/SS distribution	ongoing
Wrapper effects	
Porosity	4th Q
Surface area	ongoing
Smoke Studies	
neutron radiography	ongoing
other methods	as required

Resource Allocation

I. Proprietary Product

Wrapper

Hand sheets and pilot scale products

- Bob Rogers + technician (20% each)
- G. Bokelman's project
- A. Kallianos
- G. Keritsis
- B. Goodman's project (20%)

Paper research and development

- G. Bokelman's project
- A. Kallianos
- G. Keritsis
- Consultants (to be specified)
- V. Baliga - Microscopy

Blend

Reduced density rod	- Peter Martin, Robert Mullins
	- G. Keritsis
	- R. Comes' project
Blend modification	- R. Southwick's project (in part)
	- R. Comes' project
	- H. Grubbs
Construction	- R. Jenkins
	- R. Comes' project
	- R. Izac's project (in part)
	- H. Grubbs
	- B. Goodman's project
	- G. Keritsis

II. Methods and Mechanism

Visibility	- R. Jenkins
	- R. Comes' project
	- V. Baliga (Microscopy)
Odor	- R. Southwick's project (in part)
	- M. Jeltema and PED members
	- F. Hsu

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Irritation	- E. Thomas' project - R. Comes' project - L. Lipscomb (Chamber construction) - J. Seeman (coordinator - bioassay research)
Mechanism Studies	- K. Maloney - R. Jenkins - R. Comes' project - V. Baliga (Microscopy) - A. Kallianos

/ds

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Operational Plan

For The Development Of

Low Sidestream Products

1988

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

DEVELOPMENT OPERATIONAL PLAN
FOR REDUCED SIDESTREAM
1988

OBJECTIVE:

Develop a family of products with 55-60% reduced visibility; develop a product with 70+% reduced visibility; and modify our major brands to achieve 20% visibility reduction without sacrificing subjective acceptability.

STATUS:

In order to support the current business and have products which address the public's concern to reduce environmental tobacco smoke, a range of products varying in tar, circumference, and percent sidestream visibility reduction are under development. Currently, these products will utilize a special $CaC0_3$ cigarette paper or $Mg(OH)_2$ paper to achieve reductions in visibility plus blend and flavor modifications to achieve subjectively acceptable products. Through cooperative efforts with Chemical Research, new methods of visible and total sidestream reduction will be evaluated as they become available.

STRATEGY I:

Develop a family of products with 55-60% visibility reduction using special cigarette paper.

TACTICS AND TIMETABLE:

(A) Ultra Slim

- Determine paper specs. for calcium carbonate, magnesium hydroxide papers - 1st Qtr., 1988
- Complete flavor, blend and cigarette design optimization - 1st Qtr., 1988
- Initiate consumer testing - 1st Qtr., 1988
- Finalize Test Market Product Specs - 2nd Qtr., 1988

(B) Flavor Low Regular Candidate

- Complete POL mapping studies of Marlboro Lights-type, with and without charcoal - February, 1988
- Conduct additional consumer testing, if warranted - 1st Half, 1988
- Develop Parliament low sidestream candidate - 1st Half, 1988

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(C) Full Flavor Regular Candidate

- Complete consumer testing, with and without charcoal - 1st Half, 1988

(D) Ultra Low Tar

- Consumer test, if warranted - 1st Half, 1988

(E) Menthol

- Moog Panel testing of flavor low candidate - 1st Qtr., 1988

- Competitive testing of full flavor, ultra low, and ultra slim candidates - 1st Half, 1988

STRATEGY II:

Develop an acceptable product to meet potential competitive challenge with 70+% visibility reduction using $CaCO_3$ or $Mg(OH)_2$ paper.

TACTICS AND TIMETABLE:

(A) Determine desired $CaCO_3/Mg(OH)_2$ paper specs. - 1st Qtr., 1988

(B) Optimize blend for desired MBR and subjective characteristics - 1st Qtr., 1988

(C) Conduct internal panel testing - 2nd Qtr., 1988

(D) Consumer testing, if warranted - 2nd Half, 1988

STRATEGY III:

Modify our brands utilizing standard cigarette components to achieve 20% visibility reduction without sacrificing taste.

TACTICS AND TIMETABLE:

(A) Internal panel testing of Marlboro Lights (factory panel) - 1st Qtr., 1988

(B) POL testing - 2nd Qtr., 1988

(C) Modify other brands, if warranted - 2nd Half, 1988

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STRATEGY IV:

Continue the cooperative effort with Chemical Research to develop and evaluate new methods of visible and total sidestream reduction that could give Philip Morris a proprietary advantage.

- Continuing
  During 1988

RESOURCE ALLOCATION:

Current Cigarette Technology personnel assigned:

	Man Yrs.
Research Scientist	0.60
Engineer	0.80
T-4	0.50
T-4*	0.15
T-2	0.80

*0.85 Effort Assigned To Delta

Required During 1988 (New Personnel, Not Replacement):

A lower grade professional could be effectively utilized to expand efforts in low sidestream cigarette development, working with suppliers and Chemical Research.

OTHER AREAS IMPACTED:

	Estimated No. of Samples/ Tests To Be Submitted
Semi-Works	~250 Samples
Cigarette Testing	~250 Samples
Analytical Research	50-75 Samples
Product Evaluation	6-8 POL Tests
Flavor Evaluation	Continuous Involvement
Domestic Product Dev.	Continuous Involvement
Chemical Research	Continuous Involvement
Physical Research	Involved As Required
Leaf Dept.	
Manufacturing	
Manufacturing Services	
PM Engineering	
Purchasing	
International	
Marketing	

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CONFIDENTIAL

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: [redacted] Date: January 26, 1988

From: .R. A. Comes & R. N. Ferguson

Subject: .Operational Plan for the Sidestream Control Program

OBJECTIVE

Conduct research on sidestream smoke formation in order to understand and control three major parameters - visibility, smoke aroma and compounds reported to be irritants. Develop cigarette models with a target of 50% reduction of total sidestream smoke and evaluate these models by the end of 1990. Develop cigarette models with selective reduction in a major sidestream parameter incorporating R&D technology by the end of 1990. Integrate these results and models into the ongoing Studio product development program by the end of 1991.

STATUS AND BACKGROUND

The sidestream program has been ongoing from the product development standpoint for several years. This effort has been directed toward the establishment of defined cigarette models that meet all criteria for market place introduction as required. Potential shelf items are currently available in several configurations and at several deliveries. These potential products utilize commercially available cigarette wrappers [$Mg(OH)_2$ - Ecusta] as the primary method of sidestream smoke reduction. Subjective acceptability has been obtained by blend, flavor and filter modification.

The research aspects of the program were initiated early in 1987. They were directed toward the determination of the mechanisms by which the commercial wrappers operate, at investigations into similarities and/or differences in the chemistry of the mainstream and sidestream smoke from reduced visibility models vs suitable controls, at the structural properties of the papers and at other parameters not previously studied. The program was expanded in the third quarter of 1987 to include an "odor and irritation" study, predicated on the 1986 Report of the Surgeon General and on data generated by marketing input from Philip Morris New York personnel.

Visibility measurements are run on all models. Mass loss rate, aerosol particle size, sidestream smoke temperature, smoke particle velocity and relative particulate fraction data are generated in addition to the visibility information. Data has been obtained on the effects of blend components, on numerous commercial and experimental cigarette papers, on differences between commercially available products, on the effect of cigarette circumference and on the effects of various additives. By far, the parameter of primary importance to the control of sidestream (and mainstream) smoke is the cigarette wrapper.

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The commercial suppliers have each presented a mechanism for the successful reduction in visible sidestream smoke by the use of various additives. In simplest terms, Ecusta proposes that their $Mg(OH)_2$ wrappers encase the advancing coal leading to a reburn of the combustion products and hence an increase in gas phase components, thus yielding reduced visibility. Kimberly-Clark postulates that the surface area is the important factor influencing visibility reduction in that smoke components are trapped on the large surface area available and are then further combusted as the coal advances. They have demonstrated significant visibility reductions using papers incorporating the small particle size materials, $A\ell_2O_3$ and attapulgite clay (SiO_2). Very recently, K.C. has supplied us with fine particle size $CaCO_3$, which also demonstrates a significant reduction in visible sidestream smoke. Both of these proposed mechanisms may exert a significant influence, and in addition, evidence generated at P.M. indicates another factor may be operating as well. Very different curves are generated if plots are made of permeability vs temperature for $Mg(OH)_2$ wrappers vs conventional papers. The permeability of the $Mg(OH)_2$ wrapper appears to increase (become more porous) as the temperature increases up to the point of paper destruction. In contrast, the permeability of the conventional wrapper remains essentially constant to the destruction point. This data tends to indicate an opening of the reduced visibility paper as the temperature gradient approaches, allowing the entry of oxygen and a more complete combustion process to take place.

The commercial and experimental papers have been examined on a macro and micro scale. Light microscopy has shown differences in paper structure and "tightness" as a result of refining and changes in basis weight. Scanning electron microscopy and transmission electron microscopy have yielded important information on the structural characteristics, chemical composition and elemental distribution in papers with and without sidestream control additives. The wrappers that were most effective in reducing visible sidestream smoke appeared to have the flax fibers encased by the additive. In contrast, the conventional papers have the normal additives ($CaCO_3$ and burn control agents) randomly distributed among the fibers. However, initial microscopic examination of the recently obtained small particle size $CaCO_3$ paper shows agglomerated particles of $CaCO_3$ which do not appear to effectively cover the individual fibers. Potentially, a different mechanism is operating with this additive.

A vast literature exists on the chemistry of tobacco and of mainstream smoke. Some information on sidestream chemistry is available but it suffers from a lack of consistency in collection procedures used, a lack of uniformity in analytical techniques employed and large disparities in the data reported. Our initial efforts were directed toward designing a collection device and defining analytical procedures that would yield reproducible data at reasonable detection levels. Multiple chimney designs were investigated. Various trapping and eluting techniques were attempted. It was determined that the analysis of sidestream whole smoke generated data that was not consistent. A procedure was established, based on previous investigations for the VDC nicotine program, whereby a portion of the sidestream (or mainstream if desired) smoke from four cigarettes is trapped on a short silica gel column. The column is then serially eluted with hexane, ethyl acetate and methanol and the solvent fractions investigated by capillary gas chromatography with detection by FID, NPD and MS. This method has yielded chromatographic information that is reproducible within a given

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

cigarette type and which can be compared with data from other models. The semivolatile fractions of cigarettes with and without wrappers yielding reduced visibility sidestream smoke were investigated. It was generally concluded that there were few qualitative or quantitative differences among all of the models studied. However, 300+ compounds have been identified in sidestream smoke. The compounds have been tabulated and are searchable by various means and can be individually investigated as required.

A group has been established within the Analytical Research Division to determine appropriate analytical methodology and to conduct routine analyses on certain compounds defined as irritants in the 1986 Report of the Surgeon General. Analytical procedures (TDL and ion chromatography) have been defined for determination of ammonia in mainstream and sidestream smoke. Selected cigarette models have been investigated and data reported. Additional methods are under investigation for other components.

Radiochemical capability for total distribution studies and for precursor-product investigations has been re-established. Initial investigations have been conducted on cigarettes with and without $Mg(OH)_2$ wrappers utilizing a C-38 hydrocarbon specifically labelled with ^{14}C. Differences in distribution were noted with an increased SS gas phase and a reduced SS TPM found in the low visibility models. Some very preliminary studies using neutron radiography techniques have been carried out to determine the effect of the reduced visibility wrappers on build-up of smoke condensibles behind the advancing coal. Schlieren techniques have been used to investigate the location of the thermal and visible smoke plumes. The thermal convection column appears to be located 2-3mm in front of the paper burn line for both conventional and reduced sidestream models. However, the faint smoke plume appears directly over the paper burn line in the low sidestream papers. Some related coal temperature measurements were also initiated but not completed.

Initial studies have been carried out to determine feasibility for use of specific materials to "mask" or alter sidestream odor with little or no effect on mainstream subjectives. Anethol release compounds which decompose during cigarette smoking were studied and found to have potential benefits. Glucovanillin (CR-2673) is currently being investigated. "Ashtray aroma" was addressed and progress made to define its chemical composition. The odor profile data base was greatly expanded during 1987 and this continues with the profiling of specific materials identified in sidestream smoke.

New cigarette models have been produced for evaluation. Cigarettes with different types and levels of humectant on sheet material are available for evaluation in conventional wrappers. A wrapper incorporating small particle size $CaCO_3$ and succinate anion burn additive has been prepared for investigation of visibility reduction and subjective interest. Cigarettes have been requested with unique changes (citrate inner wrap and $Mg(OH)_2$ outer wrap) to the traditional construction.

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STRATEGIES

The following section contains strategies and tactics relevant to each strategy with approximate completion dates assigned where possible.

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Three broad strategies are recommended for the Sidestream Control Program.

I. Identify and quantitate compounds which have a significant influence on sidestream smoke odor or irritation.

Tactics and Timetables:

1. Develop and apply methods to quantitate defined irritants in smoke - ammonia, formaldehyde and acrolein (aldehydes), toluene and benzene (aromatics). 4th Q 88

2. Evaluate the literature for compound irritation thresholds and identify additional reported irritants.
   a. Complete internal and external literature searches. 1st Q 88
   b. Evaluate literature searches. Evaluate potential outside contract resources, if needed. 2nd Q 88
   c. Recommend future action plan based on a and b. 3rd Q 88

3. Design acceptable "assays" for other irritants and/or materials which elicit trigeminal effects.
   a. Conduct a literature search for available irritant bioassays. Evaluate research proposal from outside resource. 2nd Q 88
   b. Initiate a collaborative study with outside resource. 3rd Q 88

4. Conduct individual compound or whole sidestream irritant evaluation using analytical & bioassay endpoints. 4th Q 88 - 4th Q 89

5. Survey components of sidestream smoke semivolatiles and gas phase using gc/ms.
   a. Develop procedures for sidestream gas phase analysis. 1st Q 88
   b. Analyze reduced sidestream and regular cigarette models using method developed in a. 2nd Q 88
   c. Initiate odor/irritation studies by constructing a GC sniffing port. 3rd Q 88
   d. Conduct ongoing sidestream smoke component identification as new models and improved techniques become available 1st Q - 4th Q 88

6. Build a smoke component library and odor data base.
   a. Order commercially available identified smoke components for odor evaluation. 1st Q 88
   b. Complete odor profile of Dravnieks mixture. 2nd Q 88
   c. Begin synthesis of non-commercially available smoke components. 1 Q 88 and continuing

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d. Odor profile smoke components. continuing

7. Design and construct an ETS chamber where subjective and quantitative odor and irritation evaluations can be made.
   a. Travel to FTR to evaluate and define chamber design and instrumentation. Initiate 650 preparation. 1st Q 88
   b. Complete 650, modify laboratory, order chamber construction materials, order long lead time instrumentation. 2nd Q 88
   c. Construct chamber and order remaining instrumentation. 3rd Q 88
   d. Complete chamber and instrumentation installation and check-out. 4th Q 88

8. Staff and put chamber into routine use and establish baseline data for defined components.
   a. Prepare a job description, interview and hire a T-2 for chamber operation. 3rd Q 88
   b. Train hired T-2 for chamber operation. 4th Q 88

9. Utilize the chamber to quantitate initial levels and establish half-life data for selected irritants. 1989

10. Utilize the chamber to establish meaningful baseline odor evaluations using reference odorants to compare with identified smoke components. 1989

11. Define, purchase and put into use radiochemical smoke formation instrumentation capable of supporting precursor/product studies.
   a. Set up and place in operation radio/GC instrumentation. 1st Q 88
   b. Develop and apply radio/GC methodology to sidestream semivolatiles and gas phase on reduced visibility and control cigarettes. 3rd Q 88
   c. Complete set up of solenoid activated valve assembly (SAVA). 1st Q 88
   d. Apply SAVA technique to radiolabelled cigarettes. 2nd Q 88
   e. Modify total recovery smoking machine for sidestream collection in solution (non-destructive). 4th Q 88

12. Apply the radiochemical capability to:
   a. glycerine;
      1. Complete total radioactivity distribution studies on $Mg(OH)_2$ cigarettes and suitable controls. 1st Q 88
      2. Spray additional filler with ^{14}C-glycerine and prepare additional labelled cigarettes. 1st Q 88

   nicotine;
      1. Prepare radiolabelled cigarettes. 3rd Q 88

   hydrocarbons;
      1. Conduct ^{14}C-smoke studies. 4th Q 88

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b. odor and/or irritant precursors 1989

13. Identify smoke components principally associated with cigarette butt odor.
    a. Complete survey of brand and filler types. 1st Q 88
    b. Fractionate volatiles to localize characteristic odor. 1st Q 88
    c. Conduct analytical and sensory evaluation of major components of butt odor. 2nd Q 88
    d. Continue evaluation with minor components. 4th Q 88

14. Evaluate origin and possible control of compounds associated with cigarette butt odor. 1989

15. Determine if a correlation exists between components associated with lingering sidestream odor in rooms and those implicated in cigarette butt odor. 1989

16. Conduct quantitative and subjective research on vanillin release systems designed to mask sidestream odor.
    a. Select analytical method of quantitate vanillin in smoke. 2/88
    b. Evaluate method for vanillin in smoke using glucovanillin as model compound. 2nd Q 88
    c. Conduct subjective evaluations to determine acceptable application level. Prepare paper treated models at this level. 2nd Q 88
    d. Conduct analytical and subjective evaluations of chosen models. 3rd Q 88

17. Develop additional subjectively acceptable masking odors for sidestream aroma control.
    a. Based on results of glucovanillin study (16) and on input from consumer evaluation (19), initiate studies on other compounds to mask sidestream odor. 4th Q 88

18. Evaluate new product ideas with consumers - internal and/or external to PM (i.e. acceptable flavors to mask sidestream aroma). 1989

19. Use consumer evaluation methods to better define product opportunities in the general area of sidestream odor. 3rd Q 88

20. Apply developed methods for irritants/odors to evaluate Studio models or models for PM proprietary products as needed. Ongoing

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II. **Determine the mechanisms by which cigarette paper or other components of cigarette construction influence the visibility and chemistry of sidestream smoke.**

Tactics and Timetables:

1. Use the visibility measurement system to continue studies on visibility and related aspects of the smoke aerosol from selected models.
   a. Conduct visibility measurements on humectant models. 1st Q 88
   b. Conduct visibility measurements on models for FTR evaluation. 1st Q 88

2. Use the paper permeability system to evaluate the performance of new commercial models ($CaCO_3$) and P.M. designed models. Thru 1st half 1989

3. Conduct Schleiren and/or high speed photography studies on burning cigarettes; as need arises based on visibility data. Not staffed at present

4. Conduct coal temperature studies on models with significantly different visibilities. Not staffed

5. Establish an aerosol research effort to investigate composition versus aerosol particle size for sidestream smoke and study the effects of wrapper construction upon these parameters. Not staffed

6. Provide priority evaluation of Kimberly-Clark high surface area $CaCO_3$ paper since it may soon be a commercial alternative to the Ecusta $Mg(OH)_2$ wrapper.
   a. Conduct GC/MS semivolatile scans of $CaCO_3$ treated paper vs $Mg(OH)_2$ control. 1st Q 88

7. Set up a group to coordinate and conduct fundamental research studies of interest to PM on cigarette wrappers with emphasis on reduced sidestream effects. Initiate by 4th Q 88

8. Establish a hand sheet making capability to facilitate the study of new paper concepts.
   a. Order equipment and prepare facility 1st Q 88
   b. Set up equipment, training, begin casting sheets 2nd Q 88

9. Conduct microscopic examinations of various papers to relate structural parameters to sidestream visibility effects. 1st Q 1989

10. Determine the effects of various models with 50% or more visibility reduction on other parameters of interest, specifically those related to odor and irritation. 1989

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11. Investigate build-up of condensibles for normal and reduced visibility models.
    a. Install and place in operation the new image processing equipment. 1st Q 88
    b. Initiate studies at UVa with the image processor. 2nd Q 88
    c. Compare reduced visibility and control cigarette models using the image processor. 3rd Q 88
    d. Define models to investigate condensibles build-up. 4th Q 88

12. Use contract resources to study polar/non-polar nucleation effects on clustering and aerosol growth.
    a. Identify relevant areas of sidestream research for contract resources. 1st Q 88
    b. Based on program progress, decide on continuation of evaluations. 4th Q 88

13. Re-evaluate the contribution of conventional construction parameters, other than the wrapper, to sidestream visibility and chemical composition. 1989

14. Evaluate the contribution of major current additives, e.g. humectants, and of cigarette compatible salts and inorganics to visibility. 4th Q 88

III. Modify cigarettes to demonstrate reduction in total sidestream or in selected aspects or components of sidestream smoke.

Tactics and Timetables:

1. Use multiple sidestream endpoints to evaluate papers available from commercial sources.

    a. general reduction of aerosol and/or gas phase. 3rd Q 88
    b. selective reduction of specific components. 1st Q 89

2. Evaluate potential proprietary paper processes such as various inorganic additives using handsheet/handmade screening approach.

    a. general reduction of aerosol and/or gas phase. 1st Q 89
    b. selective reduction of specific components. 2nd Q 89

3. Evaluate other wrapper concepts - coated paper, embossed paper, carbon lined paper, organic polymer wrapper - with respect to:
    a. general reduction of aerosol and/or gas phase. 1st Q 89

    b. selective reduction of specific components. 3rd Q 89

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4. Re-evaluate possible use of non-tobacco smoking materials, tobacco derived NTSM, extenders, etc. admixed with tobacco on:

   a. general reduction of aerosol and/or gas phase. 4th Q 89

   b. selective reduction of specific components. 1990

5. Evaluate low density rods with optimized burn rate, binder, etc. on:

   a. general reduction of aerosol and/or gas phase. 3rd Q 88

   b. selective reduction of specific components. 1st Q 89

6. Conduct a research study of core/periphery differences in cigarettes as potential for either general or selective sidestream reduction. 1989

7. Evaluate tobacco derived carbon as a blend component to reduce sidestream. 4th Q 88

8. Extend favorable models from above studies to ETS evaluation and evaluate mainstream subjectives. 1990

9. Evaluate production parameters, costs, materials availability and smoking and health aspects of prime candidates. 1990

10. Recommend models for Studio use based on results from 9 (above). early 1991

RESOURCE ALLOCATION

1. How are personnel to be allocated?

The attached table indicates the needs of this program. These are individuals directly involved in important aspects of the program. Note that half the resources are outside the Division and are subject to many other needs, based on experience from 1987.

This program cannot make any progress without considerable cooperation among several divisions. The most critical areas for resource allocation outside of Chemical Research are:

Analytical Research	-	Irritant analysis methods, microscopy, odor fractionation identification
Product Evaluation	-	Consumer research, subjective evaluation, odor profile
Flavor Development	-	New paper and construction concepts and subjective evaluation Sidestream odor masking
Cigarette Technology	-	Hand cast paper facility and staffing Studio coordination, smoke aroma panel

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2. Do you have enough people?

This question will only be addressed with respect to the Chemical Research Division. In developing these plans it is clear that additional research needs to be done on the question of sidestream aerosol particle size and composition. A Research Scientist with an interest in the chemistry of this aerosol and methods to control this parameter would be of great value, especially in conjunction with Dr. Jenkins and the radiochemistry group. We would need a researcher with a Ph.D. and direct experience in this field. Such an individual would address areas such as Strategy II, tactics 3,4,5 which had been in long range plans for Dr. McRae.

A second priority is a technician (T-2) to address multiple needs within the smoke and radiochemistry groups. The need will be especially critical late in the year as research studies using the ETS chamber begin.

As a final note, an enlarged group of volunteers must be located and encouraged to participate in various odor evaluation studies.

3. Do you have the right people?

Within Chemical Research the answer is yes, but see the personnel needs listed above within the Division. Outside the Division the right people are in place provided the allocations requested can be met. Note especially that "man years" are not interchangeable. For example, Mr. Keritsis, Dr. Kallianos, and Mr. Pfleuger are resources in Flavor Development and cannot be replaced by the equivalent time commitment of other individuals.

4. Do you need special equipment, etc.?

A considerable impact will occur from direct equipment/facilities needs of the program. Two bays on T-7 will be used to set up the ETS chamber and associated equipment. This requires a considerable capital outlay, facilities renovation, etc. The establishment of a hand sheet preparation facility by Cigarette Technology will require special equipment and some space. The tactics to begin paper research related to sidestream will initially make use of the staff/expertise/facilities of project 1758 in Chemical Research. Aerosol chemistry would have little impact <u>in 1988</u> since most work would be associated with outside contracts. (See item 5 below).

5. Do you need outside expertise?

The answer to this question is a strong affirmative.

University of Virginia	-	Neutron radiography and aerosol balance studies
University of Washington	-	Aerosol balance
Colorado State University	-	Polar/non-polar clustering and possible reactions in aerosols
VPI & SU	-	Paper chemistry
Herty Foundation	-	Research paper production with confidentiality agreement

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Duke University	-	Possible bioassay and research on irritants or trigeminal agents
VCU	-	Resource for synthesis of selected smoke components
Dartmouth	-	Resource for possible microscopy studies of cigarette papers, commercial or proprietary

In addition, both major paper suppliers, Ecusta and Kimberly Clark, are being considered as resources in certain areas of the program.

IMPACT ON OTHER AREAS

Within R&D, a number of groups will be impacted by the planned efforts in the Sidestream Control Program. The listed impacts are in addition to direct resources for the program listed in the previous section.

Administrative Services	-	Assistance needed for lab modifications chamber construction and cast sheet facility.
Analytical Research	-	Wrapper and cigarette samples will need routine analytical support.
Cigarette Technology	-	Support needed for hand sheet casting and paper coating.
Cigarette Testing	-	Extensive support needed for Studio program and some for a few research models also.
Computer Applications	-	Implementation of MDL program will benefit sidestream components/odor studies. PE LIMS system.
Technical Information Section	-	Literature assistance/retrieval needed on irritants.
Tobacco Fundamentals	-	Models from low density rod program. Support from modified smoking materials area for Keritsis trials.
Tobacco Materials Division	-	Additives to recon will need small scale preparation.
Tobacco Services	-	Both primary and make pack areas of semiworks will need to support small model demand from research program and a number of models from Studio area (Paul Gauvin).

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IMPACTS ON OTHER DEPARTMENTS

New York Marketing Department - Program needs input from consumer studies of concepts and actual models.

FTR - Chamber associated studies on USA models will continue for all of 1988 until USA chamber is on line.

EEP - Limited support needed in training and safety aspects of new facilities - ETS chamber, etc.

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TABLE I

OPERATION PLANS 1988 - RESOURCES

BY DIVISION - MAN YEARS

	CR	ARD	ASD	BCR	C.TEC	DEV.E	FL.DEV	PRD	PED	T.FUND	T.MAT	KEY WORDS
STRATEGY I.												
Tactic 1	0.2	2.6										Irritant methods
Tactic 2	0.1											Additional irritants
Tactic 3	0.2											Contract research,irritant assay
Tactic 5	1.6											Components survey
Tactic 6	1.5								1.0			Component odor profile
Tactic 7	1.1	0.1	0.2	0.1	0.2	0.2			0.5			ETS chamber
Tactic 8	0.3											ETS staffing
Tactic 11	2.0											Radiochemical methods
Tactic 12	2.3											Contract research,smoke formation
Tactic 13	0.7	1.0							0.2			Butt odor
Tactic 16	0.5				0.1		0.2		0.2			Vanillin release
Tactic 17	0.2											SS Odor masking
Tactic 18					0.3				0.5			Consumer study
Tactic 19									0.2			N.Y. Marketing,consumer preference
STRATEGY II.												
Tactic 1	0.3											Visibility measure
Tactic 2								0.5				Permeability system
Tactic 3												Aerosol scientist,optical study
Tactic 4												Personnel required,coal temperature
Tactic 5												Aerosol scientist,aerosol chemistry
Tactic 6	0.4	0.3			0.3			0.1				K.C. wrapper
Tactic 7	1.1	0.5										Paper-fundamental studies
Tactic 8	0.2				0.1							Hand sheet capability
Tactic 9		1.0						0.4				Microscopy
Tactic 11	0.2											Condensibles
Tactic 12	0.2											Contract research,nucleation/aerosol
Tactic 14	0.2											Additives contribution
STRATEGY III.												
Tactic 1	0.1	0.1			0.1							Commercial papers
Tactic 2	0.1	0.1			0.1		0.3					Proprietary wrappers
Tactic 3		0.1			0.1		0.3					New wrapper concepts
Tactic 5	0.2	0.1					0.1			0.5		Low density rod
Tactic 7	0.1	0.1									0.5	Tobacco derived carbon

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TABLE II
Operation Plans 1988 - Man Years
Chemical Research - By Grade

	14	13	12	11	9.0	7.0	T-4	T-2
Strategy I.								
Tactic 1			0.1	0.1				
Tactic 2			0.1					
Tactic 3		0.2						
Tactic 5			0.1	1.0	0.2	0.3		
Tactic 6			0.2	1.2	0.1			
Tactic 7	0.1		0.3	0.1	0.2	0.4		
Tactic 8								0.3
Tactic 11	0.1			1.0	0.5	0.4		
Tactic 12	0.1			1.0	0.5	0.4	0.3	
Tactic 13			0.3	0.2	0.1	0.1		
Tactic 16			0.3	0.1	0.1			
Tactic 17			0.2					
Strategy II.								
Tactic 1			0.1			0.2		
Tactic 6	0.1		0.1	0.1		0.1		
Tactic 7	0.1		0.5	0.4			0.1	
Tactic 8			0.1	0.1				
Tactic 11	0.2							
Tactic 12	0.1	0.1						
Tactic 14	0.1					0.1		
Strategy III.								
Tactic 1			0.1					
Tactic 2	0.1							
Tactic 5				0.2				
Tactic 7					0.1			
TOTAL	1.0	0.3	2.5	5.5	1.8	2.0	0.4	0.3

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Tomorrow

2021555687

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: Mr. A. C. Lilly Date: November 17, 1988

From: R. W. Dwyer

Subject: Operational Plan for Project Tomorrow

OBJECTIVE

Develop formulations for all PM cigarette brands which will give reduced mass burn rates or contact heat fluxes while maintaining parity with current models. The mass-burn-rate targets are being designed for staged reductions; parity includes physical, delivery and subjective properties.

STATUS AND BACKGROUND

In order to comply with impending legislation concerning the "ignition propensity" of cigarettes, we are developing means of reducing the mass burn rates (MBR) and the rates of external heat emission of cigarettes. Although a meaningful measurement of ignition propensity has not been offered to the tobacco industry, our results indicate that the ratio of MBR-to-circumference scales with fabric ignition probability. Based on this observation, we are determining the influences of cigarette-design parameters on MBR, puff counts, and delivery properties.

STRATEGY I

Develop Marlboro-identical cigarettes with MBR's of 50, 45, and 40 mg/min.

TACTICS AND TIMETABLE

a) design, fabricate, and test 50 mg/min versions.....**completed**
b) modify and retest subjectives of 50 mg/min versions.....**1Q89**
c) design, fabricate, and test 45 mg/min versions.....**completed**
d) modify and retest subjectives of 45 mg/min versions.....**1Q89**
e) design, fabricate, and test 40 mg/min versions.....**1Q89**
f) modify and retest subjectives of 40 mg/min versions.....**2Q89**
g) compare delivery and subjective properties of low-MBR products made from high-expanded-tobacco-content blends with adhesively-bound blends.....**1Q89**
h) evaluate the production feasibility of low-MBR products in factory trials.....**1989**

STRATEGY II

Reformulate the designs of all PM brands to achieve MBR targets.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS AND TIMETABLE

a) develop computer-based cigarette-design models for predicting MBR, puff counts, and deliveries of all brands..**completed**
b) refine and test computer models.....**on-going**
c) design, fabricate, and test low-MBR versions of selected current brands.....**on-going**

STRATEGY III

Examine novel materials, processes, and designs for reducing the rates of heat emission from burning cigarettes.

TACTICS AND TIMETABLE

a) evaluate the effects of materials added to the filler...**on-going**
b) evaluate the effects of materials added to wrappers.....**on-going**

RESOURCE ALLOCATIONS

a) Cigarette Technology and Product Development...design, production, analysis, and panel testing of candidates (0.35 p.y.: .05/Man; .20/S.E.; .10/T2.)

b) Physical Research...modelling, design, and data analysis for candidates (0.5 p.y.: .25/S.S; .25/Ac.S.)

c) Cigarette Testing Services...physical and delivery testing (0.50 p.y.: .50/T2)

d) Low Density Rod Program...expertise, processing, and product for producing tobacco rods at target low densities (0.25 p.y.: .25/E.)

e) Semiworks...producing models for evaluation (0.20 p.y.: .20/T3)

f) Flavor Development...optimizing subjectives (0.15 p.y.: .15/R.S.)

g) Leaf Department...optimizing subjectives (0.15 p.y.: .15/A.S.S.)

h) Product Evaluation Division...consumer testing candidates (0.30 p.y.: .30/S.)

i) Purchasing...evaluating materials and processing costs (0.05 p.y.)

j) Engineering...implement some combination of: increased tobacco-expansion capability; equipment modifications for reduced-circumference cigarettes and increased tobacco cut widths; equipment for producing bound tobacco rods

k) Computer Applications...program support (0.10 p.y.)

l) Operations Services...implementing factory trials (0.10 p.y.)

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PHILIP MORRIS U. S. A.

CONFIDENTIAL

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: Cliff Lilly **Date:** July 14, 1988

From: J. F. Whidby

Subject: Project Tomorrow

There were no major directional changes to Project Tomorrow.

J. F. Whidby

/s
cc: J. L. Charles

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

raised 6/6/88

CONFIDENTIAL

OPERATIONAL PLAN FOR PROJECT TOMORROW

OBJECTIVE

Develop formulations for all PM cigarette brands which will give reduced mass burn rates while maintaining parity with current models. The mass burn rate targets are being developed for staged reductions; parity includes physical, delivery, and subjective properties.

STATUS AND BACKGROUND

In order to comply with impending legislation concerning the "ignition propensity" of cigarettes, we are developing means of reducing the mass burn rates of cigarettes. Although a meaningful measure of ignition propensity has not yet been determined, our results indicate that the ratio of mass-burn-rate-to-circumference scales with fabric ignition probability. Based on this observation, we are determining the influence of cigarette-design factors on mass burn rates, puff counts, and delivery properties. The first program goal is to develop and evaluate models of the Marlboro family of cigarettes at MBR targets of 50, 45, and 40 mg/min. A second goal is to develop the capability of redesigning all of our domestic brands to achieve as-yet-undefined MBR targets.

STRATEGY I

Develop Marlboro-identical cigarettes with a mass burn rates of 50, 45, and 40 mg/min.

TACTICS AND TIMETABLE

a) Reduce the MBR by increasing the tobacco shred widths, reducing the rod wrapper permeability, and using phosphate paper additives in place of citrate. Maintain the puff count on reduced-MBR cigarettes by decreasing their tobacco-rod densities. Maintain their deliveries by adjusting the filter efficiencies and ventilation levels. Preliminary models were designed and tested analytically and subjectively. For the 50 mg/min model (POL 3566), Marlboro smokers rated this candidate lower in acceptability than Marlboro controls; Winston smokers found no significant differences. More recent testing has shown that we can achieve subjective parity in limited in-house testing. For the 40 mg/min candidates (POL 3568), both Marlboro and Winston smokers rated the test samples lower than the controls. Product Development plans to consumer test subjectively-improved versions of these cigarettes in 1988: the POL testing of 50 mg/min Marlboro-like samples will be completed in the third quarter of 1988; 50 mg/min Marlboro Lights 100 candidates will be developed in the third quarter of 1988; 45 mg/min

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Marlboro 85 candidates will be developed for consumer testing in the fourth quarter of 1988; 40 mg/min Marlboro-like candidates will be fabricated with a high-expanded tobacco blend and a conventional blend which will be adhesively bound - these cigarettes will be physically and subjectively evaluated in the third quarter of 1988.

b) Develop mathematical models relating cigarette design to mass burn rate, puff count, and delivery. In order to achieve target puff numbers, such modelling must include the influences of design on the dynamic MBR during puffing. These models will be used to design candidates with equivalent physical and delivery properties as the Marlboro control. Currently a model has been developed which relates mass burn rates and puff counts to tobacco rod design and it is being evaluated as more data become available. A working model is being used to assist in the design of the next versions for consumer testing. Currently we are testing a model which predicts TPM and CO deliveries as functions of cigarette design. This aspect of the modelling should be completed and tested by the third quarter of 1988. The modelling will be refined and used on a continuing basis.

c) Evaluate the production feasibility of low-MBR products in extended factory trials. Since any such product is likely to include increased tobacco-shred cut widths and low packing densities, it is important to determine the long-term runnability of each modification under manufacturing conditions. Accompanying these trials will be cost estimations of materials and production based on those for standard cigarette models. The resulting cigarettes will be used for extended analytical and subjective validations. This will take place in the fourth quarter of 1988.

RESOURCE ALLOCATIONS

a) Product Development...design, production, analysis, and panel testing of candidates (0.15 p.y.: .03/Man; .07/S.E.; .05/S.)

b) Physical Research...modelling, design, and data analysis for candidates (1.1 p.y.: .20/S.S.; .90/Ac.S.)

c) Cigarette Testing Services...physical and delivery testing (0.35 p.y.: .35/T2)

d) Low Density Rod Program...expertise, processing, and product for producing tobacco rods at target low densities (0.10 p.y.: .10/E.)

e) Semiworks...producing models for evaluation (estimate 15 small scale, 15 large scale, and 60 make/pack runs, for a projection of 0.10 p.y.: .10/T3)

f) Flavor Development...optimizing subjectives (0.10 p.y.: .10/R.S.)

g) Leaf Department...optimizing subjectives (0.15 p.y.: .15/A.S.S.)

h) Product Evaluation Division...consumer testing candidates (0.15 p.y.: .15/S.)

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i) Operations Services...running extended factory trials (0.10 p.y.)

j) Purchasing...evaluating materials and processing costs (0.05 p.y.)

k) Engineering...implement some combination of: increased tobacco-expansion capability; equipment modifications for reduced-circumference cigarettes and increased tobacco cut widths; equipment for producing bound tobacco rods

l) Computer Applications...program support (0.10 p.y.)

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STRATEGY II

Reformulate the design of all PM brands to achieve target mass burn rates.

TACTICS AND TIMETABLE

a) Design prototypes of all products which currently have MBR's greater than 64 mg/min to MBR's of less than 60 mg/min. These include Parliament KS, B&H 100's, Marlboro Lights KS and 100's, and Merit KS. Product Development plans to accomplish this by the third quarter of 1988. The actual implementation of these designs will be decided in the fourth quarter of 1988.

b) Target, on a continuing basis, all new products to have MBR's less than 60 mg/min.

c) Develop mathematical models relating cigarette design and blend composition to mass burn rate, puff count, and delivery. Use these models to design candidates with physical and delivery properties equivalent to current brands. Have priority candidates fabricated and tested. Physical Research plans to have preliminary working models by the third quarter of 1988. The model will be used to evaluate potential designs for each PM brand on a continuing basis. Selected reformulations will be produced and tested by the fourth quarter of 1988.

d) Examine new materials and processes for controlling cigarette mass burn rates: these include low-temperature, full-blend expansions; low-density rods fabricated with unexpanded tobaccos using binders (subjective comparisons of high-ET and adhesively-bound low-density rods are planned for the third quarter of 1988); applications of salt casings to tobaccos; incorporating new materials such as IS into blends (a limited subjective comparison of an IS blend vs a Saudi blend showed parity - no further testing of IS blends is planned at this time). This work will proceed on a continuing basis, as required.

e) Develop a manufacturing implementation schedule of reformulated cigarette designs for all of our brands, on a timetable designed to allow us the greatest flexibility in achieving legislated ignition-propensity standards. The completion of this tactic is targeted for the fourth quarter of 1988.

RESOURCE ALLOCATIONS

a) Product Development...design, production, analysis, and panel testing of candidates (0.20 p.y.: .02/Man; .13/S.E.; .05/S.)

b) Physical Research...modelling, design, and data analysis for candidates (1.1 p.y.: .20/S.S; .90/Ac.S.)

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c) Cigarette Testing Services...physical and delivery testing (0.25 p.y.: .25/T2)

d) Low Density Rod Program...expertise, processing, and product for producing tobacco rods at target low densities (0.15 p.y.: .15/E.)

e) Semiworks...producing models for evaluation (0.10 p.y.: .10/T3)

f) Flavor Development...optimizing subjectives (0.10 p.y.: .10/R.S.)

g) Leaf Department...optimizing subjectives (0.15 p.y.: .15/A.S.S.)

h) Product Evaluation Division...consumer testing candidates (0.30 p.y.: .30/S.)

i) Purchasing...evaluating materials and processing costs (0.05 p.y.)

j) Engineering...implement some combination of: increased tobacco-expansion capability; equipment modifications for reduced-circumference cigarettes and increased tobacco cut widths; equipment for producing bound tobacco rods

k) Computer Applications...program support (0.10 p.y.)

l) Operations Services

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CONFIDENTIAL

OPERATIONAL PLAN FOR PROJECT TOMORROW

OBJECTIVE

Develop formulations for all PM cigarette brands which will give reduced mass burn rates while maintaining parity with current models. The mass burn rate targets are being developed for staged reductions; parity includes physical, delivery, and subjective properties.

STATUS AND BACKGROUND

In order to comply with impending legislation concerning the "ignition propensity" of cigarettes, we are developing means of reducing the mass burn rates of cigarettes. Although a meaningful measure of ignition propensity has not yet been determined, our results indicate that the ratio of mass-burn-rate-to-circumference scales with fabric ignition probability. Based on this observation, we are determining the influence of tobacco-rod design factors on mass burn rates. The first program goal is to develop and evaluate models of the Marlboro family of cigarettes at MBR targets of 50 and 40 mg/min. A second goal is to reduce the MBR values of brands which currently exceed 64 mg/min. A third goal is to reformulate the design of all of our brands to achieve as yet undefined MBR targets.

STRATEGY I

Develop Marlboro-identical 85 mm cigarettes with a mass burn rates of 50 and 40 mg/min.

TACTICS AND TIMETABLE

a) Reduce the MBR by increasing the tobacco shred widths, reducing the rod wrapper permeability, reducing the rod density, and using phosphate paper additives in place of citrate. Preliminary models were designed and tested analytically and subjectively. For the 50 mg/min model (POL 3566), Marlboro smokers rated this candidate lower in acceptability than Marlboro controls; Winston smokers found no significant differences. For the 40 mg/min candidates (POL 3568), both Marlboro and Winston smokers rated the test samples lower than the controls. Product Development plans to consumer test subjectively-improved versions of these cigarettes by the second quarter of 1988.

b) Develop mathematical models relating cigarette design to mass burn rate and delivery. In order to achieve target puff numbers, such modelling must include the influences of design on the dynamic MBR during puffing. These models will be used to design candidates with equivalent physical and delivery properties as the Marlboro control.

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Currently a model has been proposed which relates mass burn rates to tobacco rod design and it is being evaluated as more data become available. A working model is being used to assist in the design of the next versions for consumer testing. The modelling will be refined and used on a continuing basis.

c) Evaluate the production feasibility of low-MBR products in extended factory trials. Since any such product is likely to include increased tobacco-shred cut widths and low packing densities, it is important to determine the long-term runnability of each modification under manufacturing conditions. Accompanying these trials will be cost estimations of materials and production based on those for standard cigarette models. The resulting cigarettes will be used for extended analytical and subjective validations. This will take place in the fourth quarter of 1988.

RESOURCE ALLOCATIONS

a) Product Development...design, production, analysis, and panel testing of candidates (0.15 p.y.: .03/Man; .07/S.E.; .05/S.)

b) Physical Research...modelling, design, and data analysis for candidates (1.0 p.y.: .15/S.S.; .85/Ac.S.)

c) Cigarette Testing Services...physical and delivery testing (0.35 p.y.: .35/T2)

d) Low Density Rod Program...expertise, processing, and product for producing tobacco rods at target low densities (0.10 p.y.: .10/E.)

e) Semiworks...producing models for evaluation (estimate 15 small scale, 15 large scale, and 60 make/pack runs, for a projection of 0.10 p.y.: .10/T3)

f) Flavor Development...optimizing subjectives (0.10 p.y.: .10/R.S.)

g) Leaf Department...optimizing subjectives (0.15 p.y.: .15/A.S.S.)

h) Product Evaluation Division...consumer testing candidates (0.15 p.y.: .15/S.)

i) Operations Services...running extended factory trials (0.10 p.y.)

j) Purchasing...evaluating materials and processing costs (0.05 p.y.)

k) Engineering...implement some combination of: increased tobacco-expansion capability; equipment modifications for reduced-circumference cigarettes and increased tobacco cut widths; equipment for producing bound tobacco rods

l) Computer Applications...program support (0.10 p.y.)

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STRATEGY II

Reformulate the design of all PM brands to achieve target mass burn rates.

TACTICS AND TIMETABLE

a) Design prototypes of all products which currently have MBR's greater than 64 mg/min to MBR's of less than 60 mg/min. These include Parliament KS, B&H 100's, Marlboro Lights KS and 100's, and Merit KS. Product Development plans to accomplish this by the third quarter of 1988.

b) Target, on a continuing basis, all new products to have MBR's less than 60 mg/min.

c) Develop mathematical models relating cigarette design and blend composition to mass burn rate and delivery. Use these models to design candidates with physical and delivery properties equivalent to current brands. Physical Research plans to have preliminary working models by the second quarter of 1988. The model will be used to evaluate potential designs for each PM brand on a continuing basis. Selected reformulations will be produced and tested by the fourth quarter of 1988.

d) Examine new materials and processes for controlling cigarette mass burn rates: these include low-temperature, full-blend expansions; low-density rods fabricated with unexpanded tobaccos using binders; applications of salt casings to tobaccos; incorporating new materials such as IS into blends. This work will proceed on a continuing basis, as required.

e) Develop a manufacturing implementation schedule of reformulated cigarette designs for all of our brands, on a timetable designed to allow us the greatest flexibility in achieving legislated ignition-propensity standards. The completion of this tactic is targeted for the fourth quarter of 1988.

RESOURCE ALLOCATIONS

a) Product Development...design, production, analysis, and panel testing of candidates (0.20 p.y.: .02/Man; .13/S.E.; .05/S.)

b) Physical Research...modelling, design, and data analysis for candidates (1.0 p.y.: .15/S.S; .85/Ac.S.)

c) Cigarette Testing Services...physical and delivery testing (0.25 p.y.: .25/T2)

d) Low Density Rod Program...expertise, processing, and product for producing tobacco rods at target low densities (0.15 p.y.: .15/E.)

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e) Semiworks...producing models for evaluation (0.10 p.y.: .10/T3)

f) Flavor Development...optimizing subjectives (0.10 p.y.: .10/R.S.)

g) Leaf Department...optimizing subjectives (0.15 p.y.: .15/A.S.S.)

h) Product Evaluation Division...consumer testing candidates (0.30 p.y.: .30/S.)

i) Purchasing...evaluating materials and processing costs (0.05 p.y.)

j) Engineering...implement some combination of: increased tobacco-expansion capability; equipment modifications for reduced-circumference cigarettes and increased tobacco cut widths; equipment for producing bound tobacco rods

k) Computer Applications...program support (0.10 p.y.)

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PHILIP MORRIS U. S. A.

CONFIDENTIAL

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: W. G. Houck

Date: January , 1988

From: W. A. Geiszler

Subject: Project Tomorrow Status

POL Tests

(a) Phase I (POL 3566): Marlboro smokers rated Phase I candidate lower in acceptability ($p < .05$); NSD among Winston smokers

(b) Phase II (POL 3567): Test released for shipment 1/6/88

(c) Phase III (POL 3568): Both Marlboro and Winston smokers rated Phase III candidate lower in acceptability

Current Products (D. Sealey)

(a) Parliament KS: Models with normal citrate gave reduced MBR (63 to 58), increased FTC tar (9.2 to 10.4) and PC (7.8 to 8.5)

(b) B&H Deluxe UL: Models with normal citrate gave reduced MBR (61 to 58), slightly increased FTC tar (4.8 to 5.2) and PC (8.9 to 9.3)

(c) Merit 100's: Models to be made at MC with normal citrate

Other Approaches

(a) DAP on filler: Models with DAP on Marlboro filler being made this week.

(b) IS in blend: Phase III model with IS tested well in subjective screening; further models being planned

(c) Low density rod: Models with phosphate paper on low density rod included in Gus Keritsis's test being made this month

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PROPOSED IMPLEMENTATION TIMETABLE

Be prepared to implement the following changes in manufacturing:

(1)	Reduce all products to $\leq$60 MBR	2nd Qtr./88
(2)	Reduce all products to $\leq$55 MBR (phosphate or cuts/inch)	1st Qtr./89
(3)	Reduce all products to 50 MBR (Phase I: phosphate, cuts/inch, blend, tipping length)	4th Qtr./89
(4)	Reduce all products to 45 MBR (Phase II: Phase I plus porosity, blend, circumference)	
(5)	Reduce all products to 40 MBR (Phase III: Phase II plus porosity, blend)	
(6)	Reduce all products to 35 MBR (Phase IV: Phase III plus ...)	

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Plans for 1988

(a)	Develop and consumer test subjectively improved versions of Phase I, II, and III candidates	2nd Qtr., 88
(b)	Maintain current products $\leq$ 60 MBR	2nd Qtr., 88
(c)	Target new products $\leq$ 55 MBR	continuing
(d)	Develop Phase I models for B&H 100's, Marlboro Lights KS and 100's, Merit KS for consumer testing	2nd Qtr., 88
(e)	Evaluate new technologies (salt casing, low density rod, IS, etc.)	continuing
(f)	Conduct factory trials of new materials and processes	4th Qtr., 88

W. A. Geiszler

cc: J. Charles
W. Dwyer
P. Gauvin
R. Heretick
C. Moogalian
H. Spielberg
J. Whidby
G. Yatrakis

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Alternate Humectant

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CONFIDENTIAL

PHILIP MORRIS U. S. A.

I N T E R - O F F I C E C O R R E S P O N D E N C E

Richmond, Virginia

To: . Dr. Robert McCuen Date: July 25, 1988

From: . Elizabeth D. Mooz

Subject: . Third Quarter Organizational Plans for the Alternate Humectant Program (AHP) for 1988: I. Production of a PG/G-free Cigarette and II. Production of a G-free, domestic Marlboro-type cigarette for a POL test

PART I:

Objective

To produce an acceptable cigarette (domestic Marlboro-type) which is PG/G-free by the end of 1988. In order to do this, the following goals have been (or are being) accomplished.

PG/G-free feedstocks (RL, RCB, ET and ESB) were prepared.

PG/G-free casings and flavors (Burley spray, Burley top casing, Bright casing and after cut) were prepared and are being evaluated.

Background and Status

Since the second quarter Organizational Plans for the AHP for 1988 were written, (1) the following work has been done.

1. Six PG/G-free RL sheets containing 6% added isosweet and 700 ppm potassium propylparaben (K-pp) were prepared at Park 500 in March, 1988 (2). The K-pp was added to the size prep after running the plant without PG-pp for 12 hours. 65 gal of K-pp were synthesized at R & D (3) and transported to the production plant. 5 HHDS each of two control sheets were also made: one using a normal blend (with class + scrap, 3% PG, 2.5% G, and 700 PG-pp) and a special control (with all scrap and no class, plus the other components used in the control).

   Subjective evaluations of 100% cigarettes made from the six PG/G-free RL sheets were made by the Flavor Development smoking panel. The three 100% RLTC cigarettes (RLTC control, RLTC special

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control, and RLHFNC test) gave a similar response (4) and the three 100% RL150B cigarettes (RL150B control, RL150B special control, and RLBHFNC test) gave a similar response (4). Analytical results for all the PG/G-free RL sheets showed that there was 0.2% (or below) PG, and 0.2% (or below) G. Microbiological tests run on the RL sheets with 6% isosweet and K-pp, in place of PG/G and PG-pp, did not promote any deleterious microbiological effects versus control sheets (5). Zero-time pad and material balance survivability studies have been run in the Semi-works on the test and control RL sheets. The results are being evaluated. Toxicology studies were done on the test and control cigarettes and no significant differences were found between the two (6).

2. Three PG/G-free RCB sheets were made at the BL Plant in mid-April containing scrap (no class) and an additional 4% isosweet. 700 ppm K-pp was added to the slurry in the mixing tank in place of PG-pp prior to the 3 hr cook. 5 HHDS each of a normal control RCB using class tobaccos, 3% PG, 4% G and 700 ppm PG-pp and a special control using scrap (no class) with the other components similar to the control were also made (7,8).

   Subjective evaluations of 100% cigarettes made from the three PG/G-free RCB sheets (RCB control, RCB special control, and BLNC00 test) were made by the Flavor Development smoking panel. The BLC34 control and the PG/G-free, BLNC00 test cigarettes gave a similar response, while the BLNC34 special control cigarette was considered to be atypical of RCB (4). Analytical results for the PG/G-free RCB sheets showed that there was 0.2% (or below) PG, and 0.2% (or below) G. Microbiological tests run on the RCB sheets with 4% isosweet and K-pp, in place of PG/G and PG-pp, for eight of the twelve week storage study, did not promote any deleterious microbiological effects versus control sheets (9). Zero-time pad and material balance survivability studies to be run in the Semi-works on the test and control RCB sheets have been requested. Toxicology studies were done on the test and control cigarettes and anomalous results were obtained. The cigarettes were retested and accounting for dilution effects, there was no difference between the test and the control (6).

3. G-free DIET was prepared at the MC and G-free ESB was made in Louisville (DIET and ESB do not contain any PG).

   Analytical tests showed that there was 0% PG and 0.2% G for both test feedstocks. The control DIET contained 0% PG and 1.5 - 1.8% G, while the control ESB contained 0% PG and 1.3% G.

4. An initial set of PG/G-free casings and flavors have been prepared by Flavor Development Personnel (10).

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Strategies

Using PG/G-free feedstocks and casings/flavors a PG/G-free, domestic Marlboro and a control Marlboro will be made in the Semi-works.

Subjectively evaluate both cigarettes to obtain parity between the test and control.

Additional PG/G-free flavors and casings will be made and another PG/G-free, domestic Marlboro and a control Marlboro will be remade in the Semi-works, if necessary.

Tactics and Timetable

The following revised schedule of testing is projected:

8/1 - 8/12	Zero-time pad and material balance survivability of the production plant RCB sheets in the Semi-works
9/1 - 9/15	Survivability of test and control DIET and ESB feedstocks
7/25 - 9/30	Using the PG/G-free feedstocks and flavors/casings make a small-scale, blended domestic Marlboro in the Semi-works. A suitable control cigarette will also be prepared (11). Physical and chemical analyses of blended, test and control cigarettes will be done to confirm target levels (11). Subjective analyses of test and control cigarettes by Flavor Development personnel will be made (11). In the event that the first model is not satisfactory, new flavors/casings will be made and another PG/G-free blended, domestic Marlboro and a suitable control cigarette will be made in the Semi-works. It is estimated that the time necessary to remake and retest another PG/G-free blended cigarette model will take from four to six weeks (12). After a suitable PG/G-free cigarette model is obtained, maker survivability of test and control blends will be done at an appropriate time.
10/3 - 10/28	Assess data and make recommendations

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PART II:

Objective

To produce an acceptable G-free, domestic Marlboro-type, cigarette for a POL test. In order to do this, the following goals must be accomplished.

Use existing G-free feedstocks (RL, RCB, ET and ESB)

Use G-free casings and flavors (Burley spray, Burley top casing, Bright casing and after cut) prepared by Flavor Development personnel

Background and Status

Since the second quarter Organizational Plans for the AHP for 1988 were written, it was decided by management to send out a domestic POL to test the acceptability of a G-free, domestic Marlboro versus a control Marlboro. To meet this objective, the following items were done:

G-free RLTC, RL150B, and RCB Production Plant sheets were used with G-free DIET and ESB and G-free casings and flavors to make a domestic, Marlboro-type cigarette in the Semi-works. A suitable Marlboro control was also prepared. Analytical tests showed that the FTC Tar was 16.2 mg/cigt. for the test cigarette and an average value of 16.7 mg/cigt. for the control cigarette. The level of PG was about 3% for the G-free cigarette, while the value of G was 0.3%. In the control cigarette the level of PG was 1.0% and the value of G was 1.2%.

At least three different subjective analyses of the control and G-free POL cigarettes were run. As a result of the subjective findings of the Richmond Smoking Panel and the analytical information cited above, it was decided to cancel the POL test scheduled to be sent out in April (13).

Strategies

Using G-free feedstocks and casings/flavors a G-free, domestic Marlboro and a control Marlboro will be remade in the Semi-works as POL 3582.

Analytically and subjectively evaluate both cigarettes to obtain parity between the test and control.

If approved by Flavor Development personnel, the cigarettes will be sent out as POL 3582.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Tactics and Timetable

The following schedule is projected for the POL test:

7/18 - 7/22	Remake G-free POL cigarette and control with altered flavors/casings.
7/25 - 7/29	Analytical analysis and subjective analysis of remade, G-free POL cigarette and control.
8/15 - 8/19	Examine data and, if acceptable, mail out POL
9/26 - 9/30	Close out POL
10/1 - 10/31	PED personnel will analyze results and a report will be written.

Resource allocation

The following resources are necessary to complete the above work. The numbers are the estimated person-years necessary to complete the 1988 objective, based on 1785 hours/person-year.

Division	Prof.	Tech.	Total
Flavor Development	0.5		0.5
Product Evaluation	0.1		0.1
Tobacco Materials	0.5		0.5
Tobacco Processing	0.1	0.4	0.5
Biochemical Research	1.0	1.0	2.0
Analytical Research	0.9		0.9
Cigarette Testing	0.4	0.6	1.0
Computer Applications	0.6	0.1	0.7
Administrative Services	0.3	0.3	0.6
Technical Information	0.2	0.1	0.3
			7.1

It is estimated from previous experiences with this Program, that the areas that are involved with many other high priority programs are the Analytical Research Division, the Flavor Development Division (Project 2305) and the Semi-works. Of these three, getting test cigarettes through the Flavor Development area presents the greatest challenge.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Impact on other areas

Within R & D - Using the timetable and resource section it is obvious that the Flavor Development Division personnel are the key to the success of the Program throughout 1988.

Special Note - G-free Production Plant sheets (both RL and RCB) and control sheets will be exhausted after this G-free POL remake. If additional POL models or additional tests need to be run, it will be necessary to go back to Park 500 and the BL Plant and make additional G-free feedstocks.

General information regarding the program

At the Second Quarter Planning Meeting, Dr. Robert McCuen showed samples of the PG/G-free RL and RCB sheets that were made at the Production Plants. It was noticed that the PG/G-free RCB contained "blotches" or uneven coloration on the surface of the sheet. Gus Keritsis said that this phenomenon was most likely from a "non-uniform drying problem". Chuck Haywood stated that the "non-uniform mix in the BL test slurry probably arose because of the presence of isosweet and the lack of a PG/G humectant. One role that the PG/G humectants play in the mix is to keep all the solid components suspended". Bernie Laroy spoke about the "Technology Assessment Program" and stated that Cliff Lilly and John Shug (VPI & SU) are using the computer to develop "theoretical 'best-fit' models, using exact fit, Monte Carlo studies, with glycerin and water as humectants". The purpose of this project is to develop a basic understanding of "how humectants work". Information that they obtain as a result of this study may be of potential use in this project at some future time.

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: . Dr. Robert McCuen Date: May 12, 1988

From: . Elizabeth D. Mooz

Subject: . Second Quarter Organizational Plans for the Alternate Humectant Program (AHP) for 1988: I. Production of a PG/G-free Cigarette and II. Production of a G-free, domestic Marlboro-type cigarette for a POL test

PART I:

Objective

To produce an acceptable cigarette (domestic Marlboro-type) which is PG/G-free by the end of 1988. In order to do this, the following goals must be accomplished.

Produce PG/G-free feedstocks (RL, RCB, ET and ESB)

Produce PG/G-free casings and flavors (Burley spray, Burley top casing, Bright casing and after cut)

Status and Background

Since the second revised plans for the AHP for 1988 were written, (1) the following work has been done.

1. Subjective analyses of eight PG/G-free RL sheets containing various amounts of isosweet (0%, 4%, and 6%) with potassium propylparaben (K-pp) prepared in the R & D Pilot Plant showed that 6% isosweet on RL test cigarettes was the preferred choice when compared to control or 4% isosweet cigarettes (2,3). Analytical results for all the RL sheets showed that there was 0% PG and 0.3% (or below) G. Microbiological tests run on the RL sheets with various concentrations of isosweet and K-pp in place of PG/G did not promote any deleterious microbiological effects versus control sheets (4). Physical property measurements made on test and control RL sheets in a laboratory environment showed that differences in CV and OV determinations were small and not considered significant (5).

2. 15 HHDS of PG/G-free RLTC and RL150B sheet with 6% isosweet and 700 ppm K-pp were made at Park 500 the end of March (6). The K-pp was added to the size prep after running the plant without PG-pp for 12 hours. 65 gal of K-pp were synthesized at R & D (7) and transported to the production plant. 5 HHDS each of two control sheets were also made: one using a normal blend (with class + scrap, 3% PG, 2.5% G, and 700 PG-pp) and a special control (with

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all scrap and no class, plus the other components used in the control).

3. 100% handmade cigarettes were made from several handmade PG/G-free RCB sheets containing isosweet and K-pp, as well as control sheets, which were prepared in the R & D Pilot Plant. Analytical results obtained from all the RCB sheets showed that there was 0% PG and 0.3% (or below) G. Subjective analysis showed that an additional 4% isosweet on RCB test cigarettes was the preferred choice of the Flavor Development panel (8).

4. G-free DIET was prepared at the MC and G-free ESB was made in Louisville (DIET and ESB do not contain any PG). Analytical tests showed that there was 0% PG and 0.2% G for both test feedstocks.

5. 15 HHDS of PG/G-free RCB were made at the BL Plant in mid-April containing scrap (no class) and an additional 4% isosweet. 700 ppm K-pp was added to the slurry in the mixing tank in place of PG-pp prior to the 3 hr cook. 5 HHDS each were also made of a normal control RCB using class tobaccos, 3% PG, 4% G and 700 ppm PG-pp and a special control using scrap (no class) with the other components similar to the control (9,10).

Strategies

Preparation of PG/G-free casings/flavors will be handled by the personnel in the Flavor Development Division.

Using PG/G-free feedstocks and casings/flavors make a PG/G-free, domestic Marlboro in the Semi-Works. A suitable control will also be prepared.

Subjectively evaluate both cigarettes to obtain parity between the test and control.

Tactics and Timetable

The following revised schedule of testing is projected.

5/1 - 6/30	Formulate PG/G-free casings/flavors for a domestic Marlboro (11)
	Microbial analyses of production plant test and control sheets:
3/30 - 4/13	RL (RLTC and RL150B) - zero time samples only
4/18 - 4/29	RCB - 12 week storage study
	Analytical confirmation of target levels in the production plant sheets:
3/30 - 4/15	RL (RLTC and RL150B)
4/18 - 5/2	RCB

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5/2 - 6/10	Zero time survivability of the production plant sheets (RL and RCB) in the Semi-Works (survivabilities on stored materials will be done at an appropriate interval following the zero time test)
5/9 - 6/10	Make small batch cigarettes (100%) in Semi-Works from the production plant sheets
6/30 - 8/12	Zero time survivability of test and control DIET and ESB feedstocks in the Semi-Works (survivabilities on stored materials will be done at an appropriate interval following the zero time test)
6/13 - 7/8	Toxicological evaluation of small batch, 100% cigarettes
6/13 - 7/8	Subjective analysis of small batch, 100% cigarettes
7/1 - 9/2	Using the PG/G-free feedstocks and flavors/casings make blended cigarettes (domestic Marlboro) in the Semi-Works (small scale). A suitable control cigarette will also be prepared (11). Maker survivability of test and control blends will be done.
9/5 - 9/30	Physical and chemical analyses of blended, test and control cigarettes will be done to confirm target levels (11). Subjective analyses of test and control cigarettes by Flavor Development personnel (11).
10/3 - 10/28	Assess data and make recommendations

Resource Allocation

The following resources are necessary to complete the above work. The numbers in parentheses are the estimated person-years necessary to complete the 1988 objective, based on 1785 hours/person-year.

Production Plant	Person-years
Park 500:	Production of test and control RL (0.13)
BL Plant:	Production of test and control BL (0.05)
Louisville/MC:	Production of test and control ESB and DIET (.04)

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Research & Development Person-years

Project 1307; 1806	Pilot Plant support and production plant coordination (0.04)
Project 1902:	Microbiology (0.06)
Project 1904:	Alternate Humectant Program coordinator (0.3)
Project 2305:	Subjective evaluation of all cigarettes by one or more qualified people (0.05); production of PG/G-free flavors and casings (0.05)
Project 1904; 2525	Production of K-pp (0.02)
Project 6906:	Toxicology (0.11)
Analytical Res. Division:	Analyses of all test and control sheets/cigarettes to confirm target levels (0.84)
Semi-Works:	Production of all cigarettes (0.03) and survivability determinations (0.08)

It is estimated from previous experiences with this Program, that the potentially "difficult areas" (areas that are involved with many other high priority programs) are the Analytical Research Division, the Flavor Development Division (Project 2305) and the Semi-Works. Of these three, getting test cigarettes through the Flavor Development area presents the greatest challenge.

Impact on Other Areas

Within R & D - Using the timetable and resource section it is obvious that the Flavor Development Division personnel are the key to the success of the Program throughout 1988.

Outside R & D - According to the above plans, the facilities at Park 500 and the BL Plant were used in March and April. This "need" was manageable and approximated 1 line for 1 shift/per sample. G-free DIET was prepared at the MC and G-free ESB was prepared in Louisville. These arrangements were made by personnel in the Flavor Development Division.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PART II:

Objective

To produce an acceptable G-free cigarette (domestic Marlboro-type) for a POL test. In order to do this, the following goals must be accomplished.

Produce or use existing G-free feedstocks (RL, RCB, ET and ESB)

Produce G-free casings and flavors (Burley spray, Burley top casing, Bright casing and after cut)

Status and Background

Since the second revised plans for the AHP for 1988 were written, it was decided by management to send out a domestic POL to test the acceptability of a G-free, domestic Marlboro versus a control Marlboro. To meet this objective, the following items were done:

G-free RLTC and RL150B sheets made at Park 500 in 9/87 (with scrap, 4.5% PG, 0% G, and 700 ppm PG-pp) were remade into 100% cigarettes for subjective reevaluation. Analytical results of the test RL sheets showed that there was 4% PG and 0.2% G. Since the test RL cigarettes gave similar subjective responses to those of the controls (12), it was decided to reuse these RL sheets in the G-free POL test.

G-free RCB sheets (with scrap, 2% or 4% PG, 0% G, and 700 ppm PG-pp) and control sheets were made 2/88 at the BL Plant. Cigarettes (100%) were made for subjective analysis. Subjective results from the new G-free RCB cigarettes showed that 2% PG was the preferred choice when compared to control or 4% PG cigarettes (13). Analytical results for the 2% test sheet showed that the level of PG was about 2% and the level of G was about 0.3%.

G-free DIET was prepared at the MC and G-free ESB was prepared in Louisville. Analytical results showed that there was 0% PG and 0.2% G for both feedstocks.

G-free casings and flavors were prepared by personnel in the Flavor Development Division.

In April, G-free components were blended in the Semi-Works to make a domestic, Marlboro-type cigarette. A suitable Marlboro control was also prepared. Analytical tests showed that the FTC Tar was 16.2 mg/cigt. for the test cigarette and 16.7 mg/cigt. for the control cigarette. The level of PG was about 3% for the G-free cigarette, while the value of G was 0.3%.

At least three different subjective analyses of the control and G-free POL cigarettes were run. As a result of the subjective findings of the Richmond Smoking Panel, it was decided to cancel the POL test scheduled to be sent out in April due to unacceptable taste of both the control and test cigarettes.

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Tactics and Timetable

The following schedule is projected for the POL test.

5/9 - 5/20	Examine data and make recommendations for further work. Additional work may be done by personnel in the Flavor Development Division to adjust one or more of the casings/flavors.
5/23 - 6/3	Remake G-free POL cigarette and control with altered flavors/casings.
6/6 - 6/17	Analytical analysis and subjective analysis of remade, G-free cigarette and control.
6/20 - 6/24	Examine data and, if acceptable, mail out POL
8/12	Close out POL
8/15 - 9/2	PED personnel will analyze the POL results and a report will be written.

Resource Allocation

The following resources are necessary to complete the above work. The numbers in parentheses are the estimated person-years necessary to complete the 1988 objective, based on 1785 hours/person-year.

Production Plants:	Person-years:
BL Plant:	Production of test and control BL (0.05)
Louisville/MC:	Production of test and control ESB and DIET (.04)

Research & Development:	Person-years:
Project 1307	Pilot Plant support and production plant coordination (0.02)
Project 1904:	Alternate Humectant Program coordinator (0.02)
Project 2305:	Subjective evaluation of cigarettes by one or more qualified people (0.02)
Analytical Res. Division	Analyses of test and control sheets/cigarettes to confirm target levels (0.02)
Semi-Works	Production of cigarettes (0.02)

It is estimated from previous experiences with this Program, that the potentially "difficult areas" (areas that are involved with many other high priority programs) are the Analytical Research Division, the Flavor

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Development Division (Project 2305) and the Semi-Works. Of these three, getting test cigarettes through the Flavor Development area presents the greatest challenge.

Impact on Other Areas

Within R & D - Using the timetable and resource section it is obvious that the Flavor Development Division personnel are the key to the success of the Program throughout 1988.

Outside R & D - According to the above plans, the facilities at the BL Plant were used in February. This "need" was manageable and approximated 1 line for 1 shift/per sample. G-free DIET was prepared at the MC and G-free ESB was prepared in Louisville. These arrangements were made by personnel in the Flavor Development Division.

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: . Dr. Robert McCuen **Date:** January 20, 1988

From: . Elizabeth D. Mooz

Subject: . Second **Revised** Plan for the Alternate Humectant Program for 1988: Production of a PG/G-free Cigarette

Objective: To produce an acceptable cigarette (domestic Marlboro-type) which is PG/G-free by the end of 1988. In order to do this, the following goals must be accomplished.

Produce PG/G-free feedstocks (RL, RCB, ET and ESB)

Produce PG/G-free casings and flavors (Burley spray, Burley top casing, Bright casing and after cut)

Status and Background: Since the original memo was written outlining the plans for the AHP for 1988, (1) the following work has been done.

1. Eight PG/G-free RL sheets containing various amounts of isosweet (0%, 4%, and 6%) with potassium propylparaben (K-pp), were preprared in the R & D Pilot Plant. Analytical tests were run on these sheets and cigarettes (100%) were made in the Semi-Works.

2. Several handmade PG/G-free RCB sheets containing isosweet and K-pp, as well as control sheets, were made in the R & D Pilot Plant. Analytical tests are being done and handmade cigarettes (100%) were prepared.

3. Test and control sheets were made at Park 500 and the BL Plant containing PG, G, and K-pp, in the place of PG-pp. This preliminary experiment was run to test for analytical parameters and subjectives, only, before making larger quantities of PG/G-free sheets in the production plants. Ten gallons of K-pp required for these experiments were prepared in R & D (2). Samples were submitted for analytical testing and cigarette requests (100%) have been placed.

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Strategies:

Subjective results need to be obtained from #1, #2, and #3 above before production plant PG/G-free sheets are made. Depending on the results, a level for isosweet will be chosen to replace PG/G.

Make PG/G-free, TC and 150B test sheets at Park 500 containing scrap (no class), isosweet, and 700 ppm K-pp. Make Control sheets using normal blend (class + scrap), 3% PG, 2.5% G, and 700 ppm PG-pp. The mode of operation at Part 500 to produce the test sheets has already been determined based on a previous memo (3). Essentially, 700 ppm of K-pp will be added to the system at Park 500 after running the plant without PG-pp for 12 hours.

Make PG/G-free RCB sheets at the BL Plant containing stemmery by-products (no class), isosweet, and 700 ppm K-pp. Make control RCB using class tobaccos, 3 % PG, 4 % G and 700 ppm PG-pp. The mode of operation at the BL Plant to produce the test sheets has already been determined based on a previous memo (3). Essentially, 700 ppm of K-pp will be added the the slurry in place of PG-pp.

Obtain cased ET and uncased ET (G-free) from R & D Pilot Plant

Obtain ESB, with and without glycerol, from Louisville

Prepare PG/G-free casings/flavors

Using PG/G-free feedstocks and casings/flavors make a PG/G-free, domestic Marlboro in the Semi-Works. A suitable control will also be prepared.

Subjectively evaluate both cigarettes to obtain parity between test and control.

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Tactics and Timetable: The following **revised** schedule of testing is projected.

12/15 - 1/8	Analytical confirmation of target levels for # 3
1/8 - 2/26	Subjective analysis of Pilot Plant RL and RCB cigarettes (# 1 and # 2) (4)
1/11 - 1/22	Make 100% cigarettes (# 3) in Semi-Works (small batch)
1/25 - 2/26	Subjective analysis of small batch cigarettes (# 3) (4)
2/29 - 4/29	Procure PG/G-free ET (DIET) and ESB (4)
2/29 - 6/3	Formulate PG/G-free casings/flavors for domestic Marlboro (4)
2/29 - 3/4	Set up meetings with Park 500 and BL Plant personnel to schedule production plant PG/G-free sheet(s)
3/14 - 4/1	Make PG/G-free sheet at Park 500 and the BL Plant
4/1 - 4/8	Microbial analysis of RL and RCB production plant test and control sheets (zero time samples only)
4/4 - 4/15	Analytical confirmation of target levels in the production plant sheets
4/18 - 5/31	Zero time survivability of the production plant sheets in Semi-Works
4/18 - 5/31	Make small batch cigarettes (100%) in Semi-Works from the production plant sheets
5/2 - 7/29	Survivability of test and control DIET and ESB feedstocks
6/6 - 6/30	Toxicological evaluation of small batch, 100% cigarettes
6/6 - 6/30	Subjective analysis of small batch, 100% cigarettes
8/1 - 9/2	Using the PG/G-free feedstocks and flavors/casings make blended cigarettes (domestic Marlboro) in the Semi-Works (small scale) (4). A suitable control cigarette will also be prepared (4). Maker survivability of test and control blends will be done.

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9/5 - 9/30	Physical and chemical analyses of blended, test and control cigarettes will be done to confirm target levels (4). Subjective analyses of test and control cigarettes by Flavor Development personnel (4).
10/3 - 10/28	Assess data and make recommendations

Resource allocation: The following resources will be necessary to complete the above tactics. The numbers in parentheses are the estimated person-years necessary to complete the 1988 objective, based on 1785 hours/person-year.

Project 1307:	Pilot Plant support and production plant coordination **(0.02)**
Project 1806:	production of ET (DIET) **(0.02)**
Project 1902:	microbiology **(0.06)**
Project 1904:	Alternate Humectant Program responsible person **(0.3)**
Project 2305:	subjective evaluation of all cigarettes by one or more qualified people **(0.05)**; production of PG/G-free flavors and casings **(0.05)**
Project 2525:	production of K-pp **(0.02)**
Project 6906:	toxicology **(0.11)**
Analytical Res. Division:	analyses of all test and control sheets/cigarettes to confirm target levels **(0.84)**
BL Plant:	production of test and control BL **(0.05)**
Louisville:	production of test and control ESB **(0.02)**
Park 500:	production of test and control RL **(0.13)**
Semi-Works:	production of all cigarettes **(0.03)** and survivability determinations **(0.08)**

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It is estimated from previous experiences with this Program, that the potentially "difficult areas" are the Analytical Research Division, the Flavor Development Division (Project 2305) and the Semi-Works. Of these three, getting test cigarettes through the Flavor Development area presents the greatest challenge.

Impact on other areas:

Within R & D - Using the timetable and resource section it is obvious that the Flavor Development Division personnel are the key to the success of the Program throughout 1988.

Outside R & D - According to the above timetable, we expect to need the facilities at Park 500 and the BL Plant in March. This "need" should be manageable and will approximate (1 line for 1 shift).

References:

1. Mooz, E. D. Plans for the Alternate Humectant Program for 1988: Production of a PG/G-free Cigarette. Memo to E. Sanders; 1987 September 25.

2. Izac, R.; Mooz, E. Preparation of Potassium Propylparaben (K-pp). Memo to R. McCuen; 1987 December 16.

3. Mooz, E. D. Alternate Humectant Program Meeting: Use of Potassium Propylparaben in Production Plant Sheets. Memo to Distribution; 1987 October 29.

4. Parrish, K. M. Proposed Activities of Flavor Development in the Alternate Humectant Program. Memo to Mr. R. M. MCCuen; 1988 January 14.

Elizabeth D. Mooz

cc: J. Charles

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

Personal & Confidential

To: .Dr. C. K. Ellis Date: November 15, 1988

From: .R. D. Kinser and A. H. Warfield

Subject: .TSNA Priority Program Operational Plans: Revised after Third Quarter 1988 Planning Meeting

OBJECTIVE: To design a product by 1991 with MS TSNA (TSNA/mg TPM) delivery reduced 90% relative to the TPM corrected TSNA delivery of a 1987 full-flavored, blended cigarette.

STATUS AND BACKGROUND

Previous studies have indicated that mainstream (MS) TSNA arise from pyrosynthesis during smoking and transfer of filler (endogenous) TSNA into the smoke stream, and that the total delivery is also affected by some TSNA decomposition during the smoking process. Increased understanding of the formation of TSNA during curing has been obtained from two extensive curing studies, but current work aimed at reduction of TSNA transfer (distillation) is focused on selective removal of TSNA from cured filler. A continuous process whereby TSNA and alkaloids are extracted from filler and then removed from the extraction solvent by an ion exchange resin has been developed. The possibility of reducing endogenous TSNA by biochemical alteration of tobacco, resulting in lowered biogenesis of alkaloids, is being examined.

Research on the inhibition of TSNA pyrosynthesis has indicated that the amine precursors of NNN and NAT are the secondary amines nornicotine and anatabine. The amine precursor of NNK has not been identified, but our research indicates that nicotine is not the primary amine precursor of MS NNK. Disproportionately high levels of MS NNK from base webs and base webs extracted with organic solvents suggest the possibility of a "bound" form of an amine, such as "unextracted nicotine", may be the NNK precursor. Experiments to investigate this hypothesis have been initiated. Although addition of a primary amine to tobacco does not appear to be a viable means of reducing MS TSNA (NNN, NAT, and NAB are actually significantly increased), the small reduction in MS NNK following such addition will be examined further. Model studies have indicated that antioxidants accelerate TSNA thermal decomposition, that ascorbyl palmitate is more effective than propyl dihydroxyhydrocinnamate, and that NNN and NAT are more readily decomposed than NNK. TSNA pyrosynthesis does occur during the smoking of oriental (Or) tobacco when nitrate and alkaloid levels are increased to approximate the levels of these probable precursors in burley tobacco. However, the smoke from an RL made from burley and oriental CELs applied to Bu base web delivers less MS TSNA than the smoke from an RL containing the same amount of BuCEL and no OrCEL. Addition of ascorbic acid to this RL further decreases TSNA delivery, suggesting that the OrCEL affects pyro-synthesis while the antioxidant causes decomposition of endogenous TSNA. Studies to

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further evaluate the "oriental inhibitor" are planned. Cigarette circumference appears to have no effect on MS TSNA delivery on a gram filler consumed basis. Paper porosity and packing density will also be evaluated.

STRATEGIES

These plans assume that Philip Morris chooses not to exert significant influence on tobacco cultivation, and therefore concentrate on tobacco treatment methods for decreasing TSNA delivery by distillation and methods which inhibit TSNA pyrosynthesis. Control of TSNA formation requires a greater understanding of those processes than currently possessed by us or described in the scientific literature, and the plans formulated to address the various strategies include defining the mechanisms of TSNA pyrosynthesis and of TSNA transfer into mainstream smoke. This basic research also includes a strategy designed to evaluate the possibility of TSNA reduction by biochemical alterations to the tobacco plant. The plans also include examination of various a priori methods for TSNA reduction. The target date represents our best prediction for a development model without flavor optimization meeting the 90% reduction (relative to a 1987 full-flavored, blended cigarette) goal using technologies and knowledge not available at this time. The priority assigned to each strategy is indicated by the number preceding the strategy. Tactics will be designed for achievement of Strategy 9 as more information about various additives becomes available.

REDUCTION OF MS TSNA BY INHIBITING THE PYROSYNTHESIS OF TSNA

1. Reduce the levels of pyrosynthesized MS TSNA by incorporation into the cigarette design those aspects of oriental filler which result in an absence of significant TSNA pyrosynthesis from oriental tobacco.

2. Reduce the levels of pyrosynthesized MS TSNA by removal of the amine precursor(s), or decreasing the reactivity to nitrosation of the amine precursor(s).

3. Reduce the levels of pyrosynthesized MS TSNA by removing nitrosating agent(s) or precursor(s) of nitrosating agent(s), or blocking reaction pathways which form nitrosating agent(s) or which yield TSNA from the nitrosating agents.

REDUCTION OF MS TSNA BY REDUCING ENDOGENOUS TSNA IN FILLER

4. Reduce MS TSNA by selective removal of TSNA from filler.

5. Reduce MS TSNA by decreasing endogenous TSNA by biochemical alteration(s) to tobacco.

REDUCTION OF MS TSNA BY ENHANCING DECOMPOSITION OF TSNA

6. Evaluate the enhancement of TSNA decomposition during smoking as a method for reducing TSNA delivery.

REDUCTION OF MS TSNA BY ALTERING PHYSICAL/CHEMICAL PARAMETERS OF CIGARETTES

7. Reduce the levels of pyrosynthesized MS TSNA by alterations in cigarette construction parameters.

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REDUCTION OF MS TSNA BY ALTERING PHYSICAL/CHEMICAL PARAMETERS OF CIGARETTES (continued)

8. Reduce the levels of pyrosynthesized MS TSNA by manipulation of filler salt content.

9. Reduce the levels of pyrosynthesized MS TSNA by manipulation of casings typically used in cigarettes but missing from the reference cigarette.

TACTICS AND TIMETABLE

Outlined below are detailed plans for the remainder of 1988 and an overview of work planned for 1989 and 1990. Timeframes given are best estimates possible at this time and represent updates based on review of this plan at the end of the Third Quarter, 1988. No attempt has been made to allow time for possible analytical or instrumental problems; any schedule revisions needed due to these causes will be made on a quarterly basis. Included in the present revision are requests received to date from other priority programs for TSNA analyses.

FOURTH QUARTER, 1988

Oriental Inhibitor Strategy

Determine MS smoke TSNA of selected solvent-extracted Bu fillers and evaluate as potential substrate for Or tobacco component studies	Oct. 21
Prepare enough Bu - TSNA - nicotine filler (DBC Bu depleted of TSNA and nicotine but containing minor alkaloids) for use in subsequent studies	Nov. 1
Initiate organic solvent extraction of Or filler to evaluate extract as inhibitor of TSNA formation	Nov. 7
Determining effect of "local" cultivation on chemistry of oriental tobacco	Dec. 15
Oriental Model Study: Effect of OrCEL fractions on NNN formation from nornicotine and nitrite	Dec. 31
Overspray OrCEL and fractions on Bu - TSNA - nicotine filler Evaluate for inhibition of pyrosynthetic activity	Dec. 31

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Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:	
-Size nicotine bitartrate crystals and submit for preparation of microencapsulated nicotine	Nov. 30
-Prepare and evaluate nicotine release properties of a nicotine-amino acid [t-butyl 2-(3-pyridinyl)-1-pyrrolidinylacetate]	Dec. 31
-Extract green burley tobacco to remove nicotine, cure; prepare cigarettes, smoke, and analyze TSNA	Dec. 31
Replicate Hoffmann ^{14}C-nicotine addition:	
-Complete method development and assess purity of ^{14}C-nicotine	Dec. 31

Nitrosating Agent Strategy

Evaluate results of FTIR-EGA experiments carried out under oxidative conditions	Oct. 31
Add sugar and/or antioxidant to BuCEL on BuBW to test hypothesis that sugar/ammonia reaction produces scavengers of nitrosating agents active during TSNA pyrosynthesis	Oct. 31
Develop methodology and test flash heating of TPM to determine if TSNA precursors for pyrosynthetic type reactions are present	Dec. 31

Removal of Endogenous TSNA Strategy

Begin final stages of development of laboratory process for preparation of ExBu filler (TSNA, nicotine and minor alkaloid-depleted) from DBC burley:	
-Extract larger DBC burley filler sample	Nov. 1
-Prepare cigarettes from ExBu filler	Nov. 8
-Determine filler and MS smoke TSNA from ExBu filler	Dec. 15
-Analyze extract generated in above process for TSNA and alkaloids	Nov. 30
Project Art Support:	ongoing
-Alkaloid analyses of samples from Supercritical Processing	Nov. 14
Sepracor Support	ongoing

Biochemical Alterations to Tobacco Strategy

Classical purification methods	
-Complete method development	Nov. 7
-Prepare purified material in bulk (25 X enrichment, >60% recovery)	ongoing

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Biochemical Alterations to Tobacco Strategy (continued)

Immunological approach	
-Preparation of antibody from partially purified PMT prep	if necessary
Affinity chromatography	
-Continue development and select best system	Nov. 7
Electrophoretic methods	
-Complete development of a continuous flow electrophoresis system	Nov. 7
-Evaluate and apply 2-D separations to purification scheme	Begin Oct. 14
-Initial results from PDI (lab performing 2-D work)	Nov. 18
Complete development of photoaffinity labelling with ^{3}H-SAM	Oct. 28
Apply complete purification scheme to fresh extract	Begin Nov. 30

TSNA Decomposition Strategy

Continue to study effects of antioxidants on decomposition of nitrosamines in order to elucidate their possible mode of action:	
-Complete PrDHHC slow heating study	Oct. 31

Alteration of Physical/Chemical Parameters Strategy

Alteration of cigarette construction parameters:	
-Evaluate effect of paper porosity and packing density	as time permits
Manipulation of filler salt content to reduce levels of pyrosynthesized TSNA:	
-Obtain smoke TSNA of Ca added CSBW's	as time permits

Analytical Methods Development

Develop simultaneous VNA/TSNA GC/TEA analysis	as time permits
Develop SPE method for smoke TSNA workup	as time permits
Develop GC method for nicotine/minor alkaloid analysis	Oct. 31

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1989

Oriental Inhibitor Strategy

If Or solvent extract is active as TSNA pyrosynthesis inhibitor:	
Fractionate Or solvent extract	Jan. 31
Overspray Or extract and fractions on ExBu/ALK filler	Feb. 15
Evaluate above for inhibition of pyrosynthetic activity	Feb. 28
Optimize levels of active fraction(s) from CEL and/or extract	Mar. 15
Identify active component(s)	2nd-3rd Q
Add Or inhibitor + antioxidant to DBC Bu, RL, BW	4th Q
Add Or salt profile to BuCEL on BuBW to test hypothesis that Or salts contribute to the observed Or inhibitor effect	Feb. 15
Effect of pH of oriental	as time permits

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:	
Evaluate water-insoluble protein from tobacco	Mar. 31
Replicate Hoffmann ^{14}C-nicotine addition:	
-Prepare labelled cigarettes, perform preliminary smokings, and develop collection methods	Mar. 31
-Perform experiment and obtain analytical results	2nd Q
Investigate additional means of removing bound nicotine from filler	Feb. 28
Investigate proximate NNK precursor:	
Develop derivatization/HPLC method for secondary amines	Mar. 31
Apply above method to filler and smoke	2nd Q

Nitrosating Agent Strategy

Carry out selected reactions of sugars with ammonia and evaluate reaction products as scavengers of nitrosating agents during smoking	Mar. 31
Initiate studies of role of NO in nitrosation	2nd Q
Completion of studies from nitrosation proposal	3rd Q

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Removal of Endogenous TSNA Strategy

Finalize laboratory process for preparation of ExBu filler (TSNA, nicotine and minor alkaloid-depleted) from DBC burley:	
Evaluate cigarettes made from ExBu filler	
-Analytical data	Feb. 28
-Small scale subjectives	Mar. 31
Apply concentrated extract back to ExBu filler	Feb. 28
-Determine MS smoke TSNA on above filler	Mar. 15
-Analytical data	Mar. 31
-Small scale subjectives on above filler	Mar. 31
Project Art Support	ongoing
Sepracor Support	ongoing

Biochemical Alterations to Tobacco Strategy

Determine appropriate alkaloid biogenesis pathway for next modification; perform requisite enzymological studies to identify enzyme for removal; isolate enzyme	ongoing

TSNA Decomposition Strategy

Continue to study effects of antioxidants on decomposition of nitrosamines in order to elucidate their possible mode of action	ongoing

Alteration of Physical/Chemical Parameters Strategy

Alteration of cigarette construction parameters:	
-Evaluate effect of other construction parameters (paper porosity, packing density, etc.)	as time permits
Manipulation of filler salt content to reduce levels of pyrosynthesized TSNA	as time permits
Effect of trace metal content on MS TSNA delivery	as time permits

1990

Construction and evaluation of models based upon studies to date

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RESOURCE ALLOCATIONS FOR 1988

How are the personnel assigned to this program allocated?

	Professionals	Technicians
Oriental Inhibitor Strategy:	0.80	0.60
Amine Precursor Strategy:	0.65	0.50
Nitrosating Agent Strategy:	0.50	0.30
Extraction of Endogenous TSNA Strategy:	0.90	0.20
Biochemical Alteration of Tobacco Strategy:	6.20	
Decomposition of TSNA Strategy:	0.75	
Cigarette Construction Parameters Strategy:	0.70	0.15
Adjustments to Filler Salt Content Strategy:	0.05	0.05
TOTAL	10.55	1.80

ACKNOWLEDGMENTS

The assistance of the following individuals in planning the research described above is gratefully acknowledged: B. Davies, C. Ellis, S. Haut, W. Hempfling, R. Kaiser, E. Lambert, R. McCuen, R. Morgan, V. Malik, E. Mooz, H. Nakatani, M. Tickle, and T. Yu.

cc: Dr. J. L. Charles
Dr. W. P. Hempfling
Mr. A. C. Lilly
Dr. R. W. McCuen
Dr. H. Y. Nakatani
Dr. E. B. Sanders

R. D. Kiser
A. H. Wayfield

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: Mr. A. C. Lilly **Date:** July 29, 1988

From: C. Ellis

Subject: TSNA Priority Program Plans

As you requested, an updated version of the TSNA priority program plans is attached.

cc: R. Kinser
A. Warfield

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

PERSONAL &
CONFIDENTI

To: .Dr. C. K. Ellis

Date: July 24, 1988

From: .R. D. Kinser

Subject: .TSNA Priority Program Operational Plans: Revised after Second Quarter 1988 Planning Meeting

OBJECTIVE: To design a product by 1991 with MS TSNA (TSNA/mg TPM) delivery reduced 90% relative to the TPM corrected TSNA delivery of a 1987 full-flavored, blended cigarette.

STATUS AND BACKGROUND

Previous studies have indicated that mainstream (MS) TSNA arise from pyrosynthesis during smoking and transfer of filler (endogenous) TSNA into the smoke stream, and that the total delivery is also affected by some TSNA decomposition during the smoking process. Increased understanding of the formation of TSNA during curing has been obtained from two extensive curing studies, but current work aimed at reduction of TSNA transfer (distillation) is focused on selective removal of TSNA from cured filler. A continuous process whereby TSNA and alkaloids are extracted from filler and then removed from the extraction solvent by an ion exchange resin has been developed. The possibility of reducing endogenous TSNA by biochemical alteration of tobacco, resulting in lowered biogenesis of alkaloids, is being examined.

Research on the inhibition of TSNA pyrosynthesis has indicated that the amine precursors of NNN and NAT are the secondary amines nornicotine and anatabine. The amine precursor of NNK has not been identified, but our research indicates that nicotine is not the primary amine precursor of MS NNK. Disproportionately high levels of MS NNK from base webs and base webs extracted with organic solvents suggest the possibility of a "bound" form of an amine, such as "unextracted nicotine", may be the NNK precursor. Experiments to investigate this hypothesis have been initiated. Although addition of a primary amine to tobacco does not appear to be a viable means of reducing MS TSNA (NNN, NAT, and NAB are actually significantly increased), the small reduction in MS NNK following such addition will be examined further. Model studies have indicated that antioxidants accelerate TSNA thermal decomposition, that ascorbyl palmitate is more effective than propyl dihydroxyhydrocinnamate, and that NNN and NAT are more readily decomposed than NNK. TSNA pyrosynthesis does occur during the smoking of oriental (Ori) tobacco when nitrate and alkaloid levels are increased to approximate the levels of these probable precursors in burley tobacco. However, the smoke from an RL made from burley and oriental CELs applied to Bu base web delivers less MS TSNA than the smoke from an RL containing the same amount of Bu CEL and no Ori CEL. Studies to further evaluate the "oriental inhibitor" are planned. Cigarette circumference appears to have no effect on MS TSNA delivery on a gram filler consumed basis. Paper porosity and packing density will also be evaluated.

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STRATEGIES

These plans assume that Philip Morris chooses to not exert significant influence on tobacco cultivation, and therefore concentrate on tobacco treatment methods for decreasing TSNA delivery by distillation and methods which inhibit TSNA pyrosynthesis. Control of TSNA formation requires a greater understanding of those processes than currently possessed by us or described in the scientific literature, and the plans formulated to address the various strategies include defining the mechanisms of TSNA pyrosynthesis and of TSNA transfer into mainstream smoke. This basic research also includes a strategy designed to evaluate the possibility of TSNA reduction by biochemical alterations to the tobacco plant. The plans also include examination of various a priori methods for TSNA reduction. The target date represents our best prediction for a development model without flavor optimization meeting the 90% reduction (relative to a 1987 full-flavored, blended cigarette) goal using technologies and knowledge not available at this time. The priority assigned to each strategy, indicated by the number preceding the strategy, is based upon discussion with you and Dr. Sanders. With the exception of the strategy concerning oriental tobacco, this represents no significant deviation from the average of the priority assignments made by the scientists working in the program. Tactics will be designed for achievement of Strategy 9 as more information about various additives becomes available.

REDUCTION OF MS TSNA BY INHIBITING THE PYROSYNTHESIS OF TSNA

1. Reduce the levels of pyrosynthesized MS TSNA by removal of the amine precursor(s), or decreasing the reactivity to nitrosation of the amine precursor(s).

2. Reduce the levels of pyrosynthesized MS TSNA by incorporation into the cigarette design those aspects of oriental filler which result in an absence of significant TSNA pyrosynthesis from oriental tobacco.

3. Reduce the levels of pyrosynthesized MS TSNA by removing nitrosating agent(s) or precursor(s) of nitrosating agent(s), or blocking reaction pathways which form nitrosating agent(s) or which yield TSNA from the nitrosating agents.

REDUCTION OF MS TSNA BY REDUCING ENDOGENOUS TSNA IN FILLER

4. Reduce MS TSNA by selective removal of TSNA from filler.

5. Reduce MS TSNA by decreasing endogenous TSNA by biochemical alteration(s) to tobacco.

REDUCTION OF MS TSNA BY ENHANCING DECOMPOSITION OF TSNA

6. Evaluate the enhancement of TSNA decomposition during smoking as a method for reducing TSNA delivery.

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REDUCTION OF MS TSNA BY ALTERING PHYSICAL/CHEMICAL PARAMETERS OF CIGARETTES

7. Reduce the levels of pyrosynthesized MS TSNA by alterations in cigarette construction parameters.

8. Reduce the levels of pyrosynthesized MS TSNA by manipulation of filler salt content.

9. Reduce the levels of pyrosynthesized MS TSNA by manipulation of additives typically used in cigarettes but missing from the reference cigarette.

TACTICS AND TIMETABLE

Outlined below are detailed plans for the remainder of 1988 and an overview of work planned for 1989 and 1990. Timeframes given are best estimates possible at this time and represent updates based on review of this plan at the end of the Second Quarter, 1988. No attempt has been made to allow time for possible analytical or instrumental problems; any schedule revisions needed due to these causes will be made on a quarterly basis. These plans do not include investigations of methods modifications which have been assigned lower priority and which will be evaluated as time permits. Also, research areas which appear promising at this time may be found non-productive and therefore be eliminated. Similarly, results of the earlier studies will surely suggest tactics and possibly even strategies which have not yet been considered; these plans will be updated as ideas develop. Included in this revision are requests received to date from other priority programs for TSNA analyses.

THIRD QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:	
Extract green tobacco with hexane and cure	begin at harvest
Complete study of base web and unextracted nicotine	Sept. 30
Addition of models of unextracted nicotine	
Nicotine release compound	Sept. 30
Investigate nicotine/water insoluble protein connection	Initiate Aug. 1
Evaluate effect of primary amine on MS NNK from BW	Sept. 6
Study other primary amines as competitors	as needed
Continue evaluation of other alkaloids and derivatives which may be precursors:	
Develop assay for PsON	Sept. 30
Evaluation of MS TSNA from SCFE tobacco with depleted secondary amines (minor alkaloids)	Sept. 30

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Oriental Inhibitor Strategy	
Determining the effect of "local" cultivation on chemistry of oriental tobacco:	
Completion of "local" cultivation of oriental	Sept. 1
Evaluate effect of antioxidant incorporated in Bu/Ori RL	Sept. 15
Continuation of Tactic 2 from strategy 2 (if warranted):	
Tactic #2: Determine the reasons oriental does not yield significant levels of pyrosynthesized TSNA by evaluation of the following:	
CEL fractions in model experiments	Sept. 15
Nitrosating Agent Strategy	
Initiate implementation of nitrosation proposal	Aug. 22
Extraction of Endogenous TSNA Strategy	
Testing extraction/TSNA removal/addition process	Aug. 31
Subjectives on cigarettes from extracted fillers	Sept. 30
MS TSNA from cigarettes from extracted fillers	Sept. 30
Project ART support	
TSNA in water used as adsorber	Aug. 15
Support of Sepracor program	on-going
TSNA in ART products	on-going
TSNA in ART processing (traps, vessels, adsorbers)	on-going
Biochemical Alterations to Tobacco Strategy	
Characterization of PMT	
PMT stability	July 31
PMT enzyme kinetics	Aug. 31
Begin negotiations with Calgene	June 29
Optimize classical techniques and prepare enriched PMT fraction (100 μg; 1000-fold)	Sept. 30
Communicate PMT preparation methods to Calgene; initiate development of proposal for further work	Sept. 30
Monoclonal antibody preparations from Hazleton for screening at PM	July 1
Determine presence of PMT-MAb	Aug. 31
Obtain sufficient quantity of PMT-MAb	Oct. 31
TSNA Decomposition Strategy	
PrDHHC examined at higher temperature	July 15
Complete proposal for future research	July 31
Slow heating of antioxidant/TSNA mixtures	Aug. 15
Initiate implementation of homolytic cleavage proposal	Sept. 1
Cigarette Construction Parameter Strategy	
Evaluate effect of paper porosity and packing density	as time permits

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Support to other Priority Programs

Develop simultaneous VNA and TSNA gc analysis	Aug. 5
Analyze new products as requested	on-going

FOURTH QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:	
Complete analyses of cured, extracted green tobacco	Dec. 31
Addition of microencapsulated nicotine as model for unextracted nicotine	Dec. 31
Continue nicotine/water insoluble protein studies	Dec. 31
Continue evaluation of other alkaloids and derivatives which may be precursors:	
Determine PsON in fillers	Nov. 15
Study polymeric secondary amines as precursors	Dec. 31
Replicate Hoffmann ^{14}C-nicotine addition: methods development	Dec. 31

Oriental Inhibitor Strategy

Determining the effect of "local" cultivation on chemistry of oriental tobacco:	
Analysis of samples from "locally" cultivated oriental	on-going
Evaluate MS TSNA delivery from an RL composed of oriental CEL and CEL from SCFE burley on Bu base web	Nov. 1
Initiate study of salt content and oriental "inhibitor"	Nov. 15
TSNA from CEL fractions in smoking experiments	Nov. 30

Nitrosating Agent Strategy

Continue studies outlined in nitrosation proposal	on-going

Extraction of Endogenous TSNA Strategy

Evaluate samples from water condensation from CO_2 from SCFE program	Dec. 30
Investigate photolysis of TSNA as means of removal from extracting solvents	Dec. 15
Perform necessary studies in support of Sepracor program	on-going

TSNA Decomposition Strategy

Conduct smoking experiments with optimized antioxidant levels	Dec. 31
Characterize decomposition pathway from kinetic/thermodynamic perspective	Initiate
Effect of altered burn temperature on decomposition	Dec. 31

Cigarette Construction Parameters Strategy

Construction parameters studies	on-going

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1989

Addition of ^{14}C-nicotine to filler and effect on smoke TSNA
Effect of removal of alkaloid/amines by various processes on MS TSNA
Effect of trace metal content on MS TSNA delivery
Effect of pH of oriental
Initiate studies of role of NO in nitrosation
Completion of nitrosating agent studies
Evaluation of salt effects
Complete construction parameters studies

1990

Construction and evaluation of models based upon studies to date

RESOURCE ALLOCATIONS FOR 1988

How are the personnel assigned to this program allocated?

Amine Precursor Strategy:	Haut 65% Warfield 15% Kaiser 55% Kurth 55% Lambert 10% Kinser 15%
Oriental Inhibitor Strategy:	Morgan 5% Haut 15% Warfield 20% Kinser 10%
Nitrosating Agent Strategy:	Morgan 50% Kaiser 15% Kurth 15% Haut 10% Kinser 10%
Extraction of Endogenous TSNA Strategy:	Warfield 60% Tickle 25% Lambert 15% Kurth 20% Kinser 10%
Biochemical Alteration of Tobacco Strategy:	Nakatani 50% Crockett 100% Dunn 100% Malik 100% Mooz 70% Sykes 100% Yu 100%
Decomposition of TSNA Strategy:	Morgan 35% Tickle 35% Kinser 10%

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Cigarette Construction Parameters Strategy: Lambert 60%
Kaiser 15%
Kinser 5%
Morgan 10%

Adjustments to Filler Salt Content Strategy: None in 1988

Are there enough people allocated to this program?

Project 6908 Activities:

Two professionals assigned to this program in 6908 are currently working nearly full time on TSNA aspects of two other priority programs. An additional professional is on temporary assignment in Project Delta. While short term research plans have been adjusted accordingly, the long term effect of these alternate activities will likely be a delay in achievement of program objectives. Assignment of an Associate Scientist A/B to this program to assist in the support to other priority programs would significantly increase the probability of developing the reduced TSNA cigarette by 1991.

A new Research Technician III joined Project 6908 on June 20, 1988, to address a previously identified need.

Project 1904 Activities:

A biochemist with experience in immunology research is needed in addition to the personnel already assigned to this program. Applicants are currently being interviewed for this position, as well as for an Associate Scientist B to provide technical support for these studies.

Are the people allocated to this program the right people in terms of skills?

In terms of skills, the current staffing of this program appears adequate through 1989, with one exception. Four senior professionals with formal training and years of research experience in organic chemistry and analytical chemistry are assigned to this program in 6908. Three (including Ms. Hansen) junior professionals and one technician, all with significant on-the-job training in the appropriate analytical methods and all assigned to Project 6908, capably assist in the fundamental research programs and perform analyses requested by colleagues in other parts of R&D. One technician is currently in training, and should be independently performing some support functions by the end of the third quarter. Four senior professionals and two junior professionals with research experience in several biological disciplines are involved in the Project 1904 studies of biochemical alterations of tobacco. Additional expertise in biochemistry/immunology is needed in this area.

Are there special equipment and facilities and/or outside expertise required?

Other than the specialized analytical equipment already in our laboratories, the only other special equipment we foresee needing is available in the supercritical fluid extraction facility in the Physical

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Research Division and the greenhouse facility in the Chemical Research Division. Outside consultants in the area of nitrosation chemistry and/or N-N bond cleavage may be needed; the decision is dependent upon the results of literature searches planned for 1988. A contract with Hazleton Biotechnologies Company has been obtained to facilitate the research on biochemical alterations to tobacco.

IMPACT ON OTHER AREAS BOTH WITHIN AND OUTSIDE R&D

Research described in this plan will require specific assistance from the Analytical Research Division, the Chemical Research Division, and the Physical Research Division. For 1988, requests to Analytical should require 0.25 to 0.5 man-months to complete. Extractions to be requested from the Physical Research Division's supercritical fluid facility during 1988 also should be completed within 0.5 man-months. Growth of tobacco plants needed for the biochemical alterations of tobacco research will require 0.6 man-year of support from the greenhouse staff. Also part of this study is a $32,000 contract of 6 - 9 months duration with Hazleton Biotechnologies Company. Replication of experiments describing the formation of NNK reported by scientists at the American Health Foundation will require an estimated six man-months of work by members of Chemical Research. Ultimately machine-made cigarettes will be required for evaluation, but that will probably not be until 1990. Assistance and training from individuals more skilled in cigarette design than anyone currently working in this area will be required when model construction and evaluation becomes the primary task of this group.

ACKNOWLEDGMENTS

The assistance of the following individuals in planning the research described above is gratefully acknowledged: K. Hansen, S. Haut, W. Hempfling, R. Kaiser, E. Lambert, R. McCuen, R. Morgan, H. Nakatani, M. Tickle, and A. Warfield.

cc: Dr. J. L. Charles
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PHILIP MORRIS U. S. A. PERSONAL & CONFIDENTIAL

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia CONFIDENTIAL

To: .Dr. C. K. Ellis Date: April 14, 1988

From: .R. D. Kinser

Subject: .TSNA Priority Program Operational Plans

OBJECTIVE: To design a reduced TSNA product by defining the mechanisms of TSNA pyrosynthesis and of TSNA transfer into mainstream smoke and examining various a priori methods of TSNA reduction. MS TSNA (TSNA/mg TPM) delivery of the desired product will be reduced 90% relative to the TPM corrected TSNA delivery of a 1987 full-flavored, blended cigarette. The target date for the laboratory model of a reduced TSNA product without flavor optimization is 1991. The desired product will be able to deliver a range of TPM consistent with current market needs.

STATUS AND BACKGROUND

Previous studies have indicated that mainstream (MS) TSNA arise from pyrosynthesis during smoking and transfer of filler (endogenous) TSNA into the smoke stream, and that the total delivery is also affected by some TSNA decomposition during the smoking process. Increased understanding of the formation of TSNA during curing has been obtained from two extensive curing studies, but current work aimed at reduction of TSNA transfer (distillation) is focused on selective removal of TSNA from cured filler. Of the solvents examined to date, the most efficient solvent for TSNA removal is ethanol, the most selective is hexane, and the best compromise for efficiency and selectivity is isopropyl alcohol. An optimized system which employs a mixture of ethanol and hexane has been developed. Also under investigation are ion exchange resins for removing TSNA from the extraction solvents. The possibility of reducing endogenous TSNA by biochemical alteration of tobacco, resulting in lowered biogenesis of alkaloids, is being examined.

Research on the inhibition of TSNA pyrosynthesis has indicated that the amine precursors of NNN and NAT are the secondary amines nornicotine and anatabine. The amine precursor of NNK has not been identified, but our research indicates that nicotine is not the primary amine precursor of MS NNK. Disproportionately high levels of MS NNK from base webs and base webs extracted with organic solvents suggest the possibility of a "bound" form of an amine, such as "unextracted nicotine", may be the NNK precursor. Experiments to investigate this hypothesis have been initiated. The addition of salts known to alter the NO content of MS smoke has been demonstrated to alter the MS TSNA delivery of both base web and burley, but in different ways. Preliminary results suggest that addition of nitrate to a filler may have a greater affect on pyrosynthetically generated TSNA (except NNK) than addition of alkaloid. Addition of cyanuric acid, a compound used to reduce the levels of nitrogen oxides in exhaust gases, did not lower MS NO or TSNA deliveries of a burley cigarette. Cyanuric acid also had no effect on the MS NO deliveries when incorporated into non-tobacco smoking materials at a

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variety of levels. Exposure of filler to NO did not result in increases in filler TSNA content. Model studies have indicated that antioxidants accelerate TSNA thermal decomposition; these studies are continuing.

STRATEGIES

These plans assume that Philip Morris chooses to not exert significant influence on tobacco cultivation, and therefore concentrate on tobacco treatment methods for decreasing TSNA delivery by distillation and methods which inhibit TSNA pyrosynthesis. Control of TSNA formation requires a greater understanding of those processes than currently possessed by us or described in the scientific literature, and the objective for the program incorporates the need for these fundamental studies. This basic research also includes a strategy designed to evaluate the possibility of TSNA reduction by biochemical alterations to the tobacco plant. The target date represents our best prediction for a development model meeting the 90% reduction goal using technologies and knowledge not available at this time. The priority assigned to each strategy, indicated by the number preceding the strategy, is based upon discussion with you and Dr. Sanders. With the exception of the strategy concerning oriental tobacco, this represents no significant deviation from the average of the priority assignments made by the scientists working in the program. Tactics will be designed for achievement of Strategy 9 as more information about various additives becomes available.

REDUCTION OF MS TSNA BY INHIBITING THE PYROSYNTHESIS OF TSNA

1. Reduce the levels of pyrosynthesized MS TSNA by removal of the amine precursor(s), or decreasing the reactivity to nitrosation of the amine precursor(s).

2. Reduce the levels of pyrosynthesized MS TSNA by incorporation into the cigarette design those aspects of oriental filler which result in an absence of significant TSNA pyrosynthesis from oriental tobacco.

3. Reduce the levels of pyrosynthesized MS TSNA by removing nitrosating agent(s) or precursor(s) of nitrosating agent(s), or blocking reaction pathways which form nitrosating agent(s) or which yield TSNA from the nitrosating agents.

REDUCTION OF MS TSNA BY REDUCING ENDOGENOUS TSNA IN FILLER

4. Reduce MS TSNA by selective removal of TSNA from filler.

5. Reduce MS TSNA by decreasing endogenous TSNA by biochemical alteration(s) to tobacco.

REDUCTION OF MS TSNA BY ENHANCING DECOMPOSITION OF TSNA

6. Evaluate the enhancement of TSNA decomposition during smoking as a method for reducing TSNA delivery.

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REDUCTION OF MS TSNA BY ALTERING PHYSICAL/CHEMICAL PARAMETERS OF CIGARETTES

7. Reduce the levels of pyrosynthesized MS TSNA by alterations in cigarette construction parameters.

8. Reduce the levels of pyrosynthesized MS TSNA by manipulation of filler salt content.

9. Reduce the levels of pyrosynthesized MS TSNA by manipulation of additives typically used in cigarettes but missing from the reference cigarette.

TACTICS AND TIMETABLE

Outlined below are detailed plans for 1988 and an overview of work planned for 1989 and 1990. Timeframes given are best estimates possible at this time and represent updates based on review of this plan at the end of the First Quarter, 1988. No attempt has been made to allow time for possible analytical or instrumental problems; any schedule revisions needed due to these causes will be made on a quarterly basis. Serious problems were experienced with all of the gc/tea systems during the First Quarter, 1988, and plans have modified accordingly. These plans do not include investigations of methods modifications which have been assigned lower priority and which will be evaluated as time permits. Also, research areas which appear promising at this time may be found non-productive and therefore be eliminated. Similarly, results of the earlier studies will surely suggest tactics and possibly even strategies which have not yet been considered; these plans will be updated as ideas develop. In the original plan, possible requests from other priority programs were not listed below; completion dates for one study were adjusted so that one professional has been allocated time for support of these programs. In this revision some of the requests which have been received have been listed.

FIRST QUARTER 1988

Amine Precursor Strategy

Determine the effect of combining a competitive primary amine with a tobacco alkaloid and nitrosating agent in a model system and the effect on MS TSNA levels of adding a competitive primary amine or a non-alkaloid secondary amine	March 31
Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by determining:	
SS TSNA from base web	Jan. 21
Base web alkaloids	Jan. 31
Effect on MS TSNA of addition of a combination of protein and nicotine to examine the hypothesis of physical entrapment as "structure" of unextracted nicotine	
Plans for experiments	March 15
Initiate work on confirmation of NNK in base web	Jan. 15

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Oriental Inhibitor Strategy

Ascertain the existence of a chemical inhibitor in oriental tobacco to TSNA formation/pyrosynthesis by determining:	
Delivery of MS TSNA from Bu CEL and MT CEL on Bu base web vs. Bu CEL on Bu base web	March 15
MS TSNA from washed oriental and precursors	March 15
Minor alkaloids in oriental	Jan. 31
TSNA in MT SS	Jan. 21
The effect of "local" cultivation on chemistry of oriental tobacco:	
Determine appropriateness of abienol study samples for study of "local" cultivation of oriental	March 31

Nitrosating Agent Strategy

Initiate literature search relevant to nitrosation of secondary amines (conditions for reactions and structures of possible nitrosating agents)	Jan. 15
Complete study of nitrate on base web	Feb. 15
Continue development of model for nitrosation agent add-backs	on-going

Extraction of Endogenous TSNA Strategy

Establish optimum conditions for extraction of TSNA	on-going
Examination of ion-exchange resins for removal of TSNA from extraction solvents	on-going
Perform necessary studies in support of Sepracor program	on-going

TSNA Decomposition Strategy

Initiate literature search relevant to homolytic cleavage of N-N bonds	Feb. 15
Continue characterization of antioxidants as decomposition aids	on-going

Support to Other Priority Programs

Development of analytical techniques for VNA determination	March 1
Determine TSNA deliveries for 1R4F	March 1

SECOND QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:	
Initiate study of unextracted nicotine and base web NNK	July 1
Select model(s) for physically entrapped nicotine studies	April 15
Initiate experiments using above models	May 17

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Confirmation of NNK in base web	on-going
Identify other alkaloids which may be precursors:	
Development of assay for PsON	July 1
Replicate Hoffmann experiments with ^{14}C-nicotine	July 1

Oriental Inhibitor Strategy

Determining the effect of "local" cultivation on chemistry-of oriental tobacco:	
Initiate efforts to cultivate oriental "locally" if needed	April 1
Determine levels of unextracted nicotine in oriental	June 30
Compare MS TSNA delivery from oriental + alkaloid + nitrate with those from similarly treated bright	June 15
Initiate Tactic #2 of Strategy 2 if warranted:	
Tactic #2: Determine the reasons oriental does not yield significant levels of pyrosynthesized TSNA by evaluation of the following:	
CEL fractions in model reactions	initiate May 1

Nitrosating Agent Strategy

Complete literature search; write detailed proposal on nitrosation studies	July 1
Continue development of model for nitrosating agent study	on-going
Test organic-nitrite complex as nitrosating agent	June 15
Complete development of TEA measurement of puffXpuff NO	July 1

Extraction of Endogenous TSNA Strategy

Establish optimum conditions for extraction of TSNA	April 30
Complete development of process for extraction of TSNA and removal of TSNA from solvent as a concerted process	May 15
Perform necessary studies in support of Sepracor program	on-going
Evaluate samples from water adsorber for SCFE	May 31
Evaluate effect of photodissociation of NO-containing molecules	June 30?

Biochemical Alterations to Tobacco Strategy

Harvest tobacco root material	on-going
Optimize classical chromatographic techniques	May 31
Obtain monoclonal antibody from Hazleton	May 31

TSNA Decomposition Strategy

Complete characterization of antioxidants as decomposition aids	May 15
Complete literature search on catalyst for homolytic cleavage; write proposal	July 1

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Cigarette Construction Parameters Strategy

Initiate cigarette construction parameters study (Paper porosity, packing density, circumference)	April 30
Initiate preparation of other cigarettes for remainder of study	June 30

Support to Other Priority Programs

Support to FTR	April 12
TSNA content of waxes from Project ART	May 15
Samples from SCFE program	June 30

THIRD QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:	
Extract green tobacco with SCF and cure	as SCF schedule permits
Complete study of base web and unextracted nicotine	Sept. 30
Continue study of "trapped nicotine"	on-going
Continue evaluation of other alkaloids and derivatives which may be precursors:	
Determine PsON levels in fillers	Aug. 15
Initiate study of polymeric secondary amine as precursor	July 1
Evaluation of MS TSNA from SCFE tobacco with depleted secondary amines (minor alkaloids)	Sept. 15

Oriental Inhibitor Strategy

Determining the effect of "local" cultivation on chemistry of oriental tobacco:	
Completion of "local" cultivation of oriental	Sept. 1
Evaluate MS TSNA delivery from an RL composed of oriental CEL and CEL from SCFE burley on Bu base web	Sept. 15
Continuation of Tactic 2 from strategy 2 (if warranted):	
Tactic #2: Determine the reasons oriental does not yield significant levels of pyrosynthesized TSNA by evaluation of the following:	
CEL fractions in smoking experiments	Aug. 1
Organic extract from oriental applied to filler	Sept. 1
Organic extract from MT CEL applied to filler	Oct. 1

Nitrosating Agent Strategy

Initiate implementation of nitrosation proposal	Aug. 22
Initiate study of scavengers for nitrosating agent	Aug. 15

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Extraction of Endogenous TSNA Strategy

Testing extraction/TSNA removal/addition process	Aug. 31
Subjectives on cigarettes from extracted fillers	Sept. 30
Perform necessary studies in support of Sepracor program	on-going
Evaluate samples from water condensation from CO_2 from SCFE program	Sept. 30

Biochemical Alterations to Tobacco Strategy

Complete purification and screening procedures with the antibody and PMT assays	July 1
Obtain 60 μg of protein	August 1

TSNA Decomposition Strategy

Conduct smoking experiments with optimized antioxidant levels	Sept. 1
Initiate implementation of homolytic cleavage proposal	Sept. 15

Cigarette Construction Parameter Strategy

Continue evaluation of construction parameters	on-going

FOURTH QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:	
Complete analyses of cured, extracted green tobacco	Dec. 31
Continue evaluation of other alkaloids and derivatives which may be precursors:	
Complete study of polymeric secondary amines	Dec. 31

Oriental Inhibitor Strategy

Determining the effect of "local" cultivation on chemistry of oriental tobacco:	
Analysis of samples from "locally" cultivated oriental	on-going

Nitrosating Agent Strategy

Initiate quantitative study of effect of nitrate	Oct. 1
Initiate protein study	Oct. 1
Continue study of scavengers for nitrosating agents	on-going
Continue studies outlined in nitrosation proposal	on-going

Extraction of Endogenous TSNA Strategy

Investigate photolysis of TSNA as means of removal from extracting solvents	
Using PM equipment	Nov. 15
Using commercially available thin-film reactors	Dec. 15
Perform necessary studies in support of Sepracor program	on-going

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TSNA Decomposition Strategy

Characterize decomposition pathway from kinetic/thermodynamic perspective	Initiate
Effect of altered burn temperature on decomposition	Dec. 31

Cigarette Construction Parameters Strategy

Continue construction parameters studies	Dec. 31

1989

Effect of removal of alkaloid/amines by various processes on MS TSNA
Effect of trace metal content on MS TSNA delivery
Effect of pH of oriental
Complete protein and nitrate study
Initiate studies of role of NO in nitrosation
Completion of nitrosating agent studies
Evaluation of salt effects
Complete construction parameters studies

1990

Construction and evaluation of models based upon studies to date

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RESOURCE ALLOCATIONS FOR 1988

How are the personnel assigned to this program allocated?

Amine Precursor Strategy:
Haut 65%
Warfield 15%
Kaiser 55%
Lambert 10%
Kinser 15%

Oriental Inhibitor Strategy:
Morgan 5%
Haut 15%
Warfield 20%
Kinser 10%

Nitrosating Agent Strategy:
Morgan 50%
Kaiser 15%
Haut 10%
Kinser 10%

Extraction of Endogenous TSNA Strategy:
Warfield 60%
Tickle 25%
Lambert 15%
Kinser 10%

Biochemical Alteration of Tobacco Strategy:
Nakatani 50%
Dunn 100%
Malik 100%
Mooz 70%
Sherwood 100%
Sykes 100%

Decomposition of TSNA Strategy:
Morgan 35%
Tickle 35%
Kinser 10%

Cigarette Construction Parameters Strategy:
Lambert 60%
Kaiser 15%
Kinser 5%
Morgan 10%

Adjustments to Filler Salt Content Strategy: None in 1988

Are there enough people allocated to this program?

Project 6908 Activities:

At the end of 1987, the number of people allocated to this program was decreased when Kathy Hansen was temporarily assigned to the Project Delta priority program. Since it was predicted that her involvement in Project Delta would continue for at least six months, the plans outlined in this document do not include any contributions from Ms. Hansen, and do not represent the rate of accomplishment that would be possible if Kathy were participating in this work. While an additional Associate Scientist did join the project in mid-October, this individual has little experience with

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chemical analysis, will not be completely trained until the end of first quarter, 1988, and will probably require close supervision for at least one other quarter. Ms. Hansen's skills in performing accurate analyses, interpreting the data, and communicating the results enabled her to independently perform much of the TSNA support function. This in turn permitted us to provide a high level of support to other R&D programs while continuing the more fundamental research designed to achieve our primary goal of MS TSNA reduction. Obviously, even strict adherence to the plans prepared assuming Ms. Hansen's absence will result in a slower rate of progress than would be achieved if Ms. Hansen, who has two years of research experience in this area, were participating in nitrosamine research. A support request from a high priority special program has already been received which requires pushing forward estimated completion dates for some of the 1988 plans. The timetable prepared also eliminated any improvements to the analytical methods currently employed, since this work is typically assigned a lower priority and there were no professionals available to conduct such studies. Due to the uncertainty in length of Ms. Hansen's current assignment, allocation of another professional to this program for the time of her absence would ensure that nitrosamine support functions are performed in a timely manner and that the nitrosamine research program timetable outlined in this document is met. Therefore, I recommend assignment of either an Associate Scientist A or B to this program for the duration of Ms. Hansen's involvement with the Delta priority program.

Also, there is only one full-time technician currently supporting the work of five professionals; until third quarter, 1987, there were two technicians. A technician already in the group is being trained to assist in nitrosamine analyses, but this individual is allocated primarily to the Lowered Biological Activity program and could be utilized less than 20% of the time. An increase in technician support of this program by addition of one Research Lab Technician III is needed.

When these plans were prepared in January of this year, information as to the number of TSNA analyses needed by other priority programs was not readily available. As the year has progressed, several requests have been received from two other priority programs and our colleagues at FTR R&D. Research addressing one strategy as been postponed an entire quarter because there are not enough people currently assigned to the TSNA program to conduct the planned research and address the unplanned support requests.

Project 1904 Activities:

A biochemist with experience in immunology research is needed in addition to the personnel already assigned to this program.

Are the people allocated to this program the right people in terms of skills?

In terms of skills, the current staffing of this program appears adequate through 1989, with one exception. Four senior professionals with formal training and years of research experience in organic chemistry and analytical chemistry are assigned to this program in 6908. Three (including Ms. Hansen) junior professionals and one technician, all with significant on-the-job training in the appropriate analytical methods and all assigned to Project 6908, capably assist in the fundamental research programs and

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perform analyses requested by colleagues in other parts of R&D. Four senior professionals and one junior professional with research experience in several biiological disciplines are involved in the Project 1904 studies of biochemical alterations of tobacco. Additional expertise in biochemistry/immunology is needed in this area.

Are there special equipment and facilities and/or outside expertise required?

Other than the specialized analytical equipment already in our laboratories, the only other special equipment we foresee needing is available in the supercritical fluid extraction facility in the Physical Research Division and the greenhouse facility in the Chemical Research Division. Outside consultants in the area of nitrosation chemistry and/or N-N bond cleavage may be needed; the decision is dependent upon the results of literature searches planned for 1988. A contract with Hazleton Biotechnologies Company has been obtained to facilitate the research on biochemical alterations to tobacco.

IMPACT ON OTHER AREAS BOTH WITHIN AND OUTSIDE R&D

Research described in this plan will require specific assistance from the Analytical Research Division, the Chemical Research Division, and the Physical Research Division. For 1988, requests to Analytical should require 0.25 to 0.5 man-months to complete. Extractions to be requested from the Physical Research Division's supercritical fluid facility during 1988 also should be completed within 0.5 man-months. Growth of tobacco plants needed for the biochemical alterations of tobacco research will require 0.6 man-year of support from the greenhouse staff. Also part of this study is a $32,000 contract of 6 - 9 months duration with Hazleton Biotechnologies Company. Replication of experiments describing the formation of NNK reported by scientists at the American Health Foundation will require an estimated six man-months of work by members of Chemical Research. Ultimately machine-made cigarettes will be required for evaluation, but that will probably not be until 1990. Assistance and training from individuals more skilled in cigarette design than anyone currently working in this area will be required when model construction and evaluation becomes the primary task of this group.

ACKNOWLEDGMENTS

The following participants in the nitrosamine research program in Project 6908 contributed to the planning process for all strategies except biochemical alterations to tobacco: K. Hansen, S. Haut, R. Kaiser, E. Lambert, R. Morgan, M. Tickle, and A. Warfield. Research on biochemical alterations to tobacco was planned by W. Hempfling, R. McCuen, and H. Nakatani.

cc: Dr. J. L. Charles
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Mr. A. C. Lilly
Dr. R. W. McCuen
Dr. H. Y. Nakatani
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PHILIP MORRIS U. S. A.

RESTRICTED DISTRIBUTION

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

PERSONAL & CONFIDENTIAL

To: .Dr. C. K. Ellis **Date:** February 29, 1988

From: .R. D. Kinser

Subject: .TSNA Priority Program Operational Plans--Revised

OBJECTIVE: To design a reduced TSNA product by defining the mechanisms of TSNA pyrosynthesis and of TSNA transfer into mainstream smoke and examining various a priori methods of TSNA reduction. MS TSNA (TSNA/mg TPM) delivery of the desired product will be reduced 90% relative to the TPM corrected TSNA delivery of a 1987 full-flavored, blended cigarette. The target date for the laboratory model of a reduced TSNA product without flavor optimization is 1991. The desired product will be able to deliver a range of TPM consistent with current market needs.

STATUS AND BACKGROUND

Previous studies have indicated that mainstream (MS) TSNA arise from pyrosynthesis during smoking and transfer of filler (endogenous) TSNA into the smoke stream, and that the total delivery is also affected by some TSNA decomposition during the smoking process. Increased understanding of the formation of TSNA during curing has been obtained from two extensive curing studies, but current work aimed at reduction of TSNA transfer (distillation) is focused on selective removal of TSNA from cured filler. Of the solvents examined to date, the most efficient solvent for TSNA removal is ethanol, the most selective is hexane, and the best compromise for efficiency and selectivity is isopropyl alcohol. Also under investigation are methods for removing TSNA from the extraction solvents.

Research on the inhibition of TSNA pyrosynthesis has indicated that the amine precursors of NNN and NAT are the secondary amines nornicotine and anatabine. The amine precursor of NNK has not been identified, but our research indicates that nicotine is not the primary amine precursor of MS NNK. Disproportionately high levels of MS NNK from base webs and base webs extracted with organic solvents suggest the possibility of a "bound" form of an amine, such as "unextracted nicotine", may be the NNK precursor. Experiments to investigate this hypothesis have been initiated. The addition of salts known to alter the NO content of MS smoke has been demonstrated to alter the MS TSNA delivery of both base web and burley, but in different ways. Preliminary results suggest that addition of nitrate to a filler may have a greater affect on pyrosynthetically generated TSNA (except NNK) than addition of alkaloid. Addition of cyanuric acid, a compound used to reduce the levels of nitrogen oxides in exhaust gases, did not lower MS NO or TSNA deliveries of a burley cigarette. Cyanuric acid also had no effect on the MS NO deliveries when incorporated into non-

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tobacco smoking materials at a variety of levels. Exposure of filler to NO did not result in increases in filler TSNA content. Model studies have indicated that antioxidants may accelerate TSNA thermal decomposition; these studies are continuing.

STRATEGIES

These plans assume that Philip Morris chooses to not exert significant influence on tobacco cultivation, and therefore concentrate on tobacco treatment methods for decreasing TSNA delivery by distillation and methods which inhibit TSNA pyrosynthesis. Control of TSNA formation requires a greater understanding of those processes than currently possessed by us or described in the scientific literature, and the objective for the program includes the need for these fundamental studies. The target date represents our best prediction for a development model meeting the 90% reduction goal **using technologies and knowledge not available at this time**. The priority assigned to each strategy, indicated by the order in which the strategies are presented, is based upon discussion with you and Dr. Sanders. With the exception of the strategy concerning oriental tobacco, this represents no significant deviation from the average of the priority assignments made by the scientists working in the program. Tactics will be designed for achievement of Strategy 8 if it is deemed a viable strategy from a management perspective.

1. Reduce the levels of pyrosynthesized MS TSNA by removal of the amine precursor(s), or decreasing the reactivity to nitrosation of the amine precursor(s).

2. Reduce the levels of pyrosynthesized MS TSNA by incorporation into the cigarette design those aspects of oriental filler which result in an absence of significant TSNA pyrosynthesis from oriental tobacco.

3. Reduce the levels of pyrosynthesized MS TSNA by removing nitrosating agent(s) or precursor(s) of nitrosating agent(s), or blocking reaction pathways which form nitrosating agent(s) or which yield TSNA from the nitrosating agents.

4. Reduce MS TSNA by selective removal of TSNA from filler.

5. Evaluate the enhancement of TSNA decomposition during smoking as a method for reducing TSNA delivery.

6. Reduce the levels of pyrosynthesized MS TSNA by alterations in cigarette construction parameters.

7. Reduce the levels of pyrosynthesized MS TSNA by manipulation of filler salt content.

8. Reduce the levels of pyrosynthesized MS TSNA by manipulation of additives typically used in cigarettes but missing from the reference cigarette.

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TACTICS AND TIMETABLE

Outlined below are detailed plans for 1988 and an overview of work planned for 1989 and 1990. Timeframes given are best estimates possible at this time and will be reviewed and revised on a quarterly basis. No attempt has been made to allow time for possible analytical or instrumental problems; any schedule revisions needed due to these causes will be made on a quarterly basis. These plans do not include investigations of methods modifications which have been assigned lower priority and which will be evaluated as time permits. Also, research areas which appear promising at this time may be found non-productive and therefore be eliminated. Similarly, results of the earlier studies will surely suggest tactics and possibly even strategies which have not yet been considered; these plans will be updated as ideas develop. In the original plan, possible requests from other priority programs were not listed below; completion dates for one study were adjusted so that one professional has been allocated time for support of these programs. In this revision some of the requests which have been received have been listed.

FIRST QUARTER 1988

Amine Precursor Strategy

Determine the effect of combining a competitive primary amine with a tobacco alkaloid and nitrosating agent in a model system and the effect on MS TSNA levels of adding a competitive primary amine or a non-alkaloid secondary amine — March 31

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by determining:

- SS TSNA from base web — Jan. 21
- Base web alkaloids — Jan. 31
- Effect on MS TSNA of addition of a combination of protein and nicotine to examine the hypothesis of physical entrapment as "structure" of unextracted nicotine
  - Plans for experiments — March 15

Initiate work on confirmation of NNK in base web — Jan. 15

Oriental Inhibitor Strategy

Ascertain the existence of a chemical inhibitor in oriental tobacco to TSNA formation/pyrosynthesis by determining:

- Delivery of MS TSNA from Bu CEL and MT CEL on Bu base web vs. Bu CEL on Bu base web — March 15
- MS TSNA from washed oriental and precursors — March 15
- Minor alkaloids and unextracted nicotine in oriental — Jan. 31
- TSNA in MT SS — Jan. 21
- The effect of "local" cultivation on chemistry of oriental tobacco:
  - Determine appropriateness of abienol study samples for study of "local" cultivation of oriental — March 31

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Nitrosating Agent Strategy

Initiate literature search relevant to nitrosation of secondary amines (conditions for reactions and structures of possible nitrosating agents)	Jan. 15
Complete study of nitrate on base web	Feb. 15
Continue development of model for nitrosation agent add-backs	on-going

Extraction of Endogenous TSNA Strategy

Establish optimum conditions for extraction of TSNA	on-going
Examination of ion-exchange resins for removal of TSNA from extraction solvents	March 31
Perform necessary studies in support of Sepracor program	on-going

TSNA Decomposition Strategy

Initiate literature search relevant to homolytic cleavage of N-N bonds	Feb. 15
Continue characterization of antioxidants as decomposition aids	on-going

Support to Other Priority Programs

Development of analytical techniques for VNA determination	March 1
Determine TSNA deliveries for 1R4F	March 1
TSNA content of waxes from Project ART	March 21
Support to PME	March 21

SECOND QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:

Initiate study of unextracted nicotine and base web NNK	April 1
Extract green tobacco with SCF	May 15
Curing of extracted green half-complete	June 30
Confirmation of NNK in base web	May 15
Identify other alkaloids which may be precursors:	
Development of assay for PsON	July 1
Replicate Hoffmann experiments with ^{14}C-nicotine	July 1

Oriental Inhibitor Strategy

Determining the effect of "local" cultivation on chemistry of oriental tobacco:

Initiate efforts to cultivate oriental "locally" if needed	April 1

Initiate Tactic #2 of Strategy 2 if warranted:

Tactic #2: Determine the reasons oriental does not yield significant levels of pyrosynthesized TSNA by evaluation of the following:

CEL fractions in model reactions	June 1
CEL fractions in smoking experiments	July 1

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Nitrosating Agent Strategy

Complete literature search; write detailed proposal on nitrosation studies	July 1
Continue development of model for nitrosating agent study	on-going
Test organic-nitrite complex as nitrosating agent	June 15
Complete development of TEA measurement of puffXpuff NO	July 1

Extraction of Endogenous TSNA Strategy

Establish optimum conditions for extraction of TSNA	April 30
Complete development of process for extraction of TSNA and removal of TSNA from solvent as a concerted process	July 1
Perform necessary studies in support of Sepracor program	on-going

TSNA Decomposition Strategy

Complete characterization of antioxidants as decomposition aids	May 15
Complete literature search on catalyst for homolytic cleavage; write proposal	July 1

Cigarette Construction Parameters Strategy

Initiate cigarette construction parameters study	April 15
Initiate preparation of other cigarettes for remainder of study	June 30

THIRD QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:

Complete curing of extracted green	Sept. 15
Complete study of base web and unextracted nicotine	Sept. 30

Continue evaluation of other alkaloids and derivatives which may be precursors:

Determine PsON levels in fillers	Aug. 15
Initiate study of polymeric secondary amine as precursor	July 1

Oriental Inhibitor Strategy

Determining the effect of "local" cultivation on chemistry of oriental tobacco:

Completion of "local" cultivation of oriental	Sept. 1

Continuation of Tactic 2 from strategy 2 (if warranted):

Tactic #2: Determine the reasons oriental does not yield significant levels of pyrosynthesized TSNA by evaluation of the following:

Organic extract from oriental applied to filler	Aug. 1
Organic extract from MT CEL applied to filler	Sept. 1

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Nitrosating Agent Strategy

Initiate implementation of nitrosation proposal	Aug. 22
Initiate study of scavengers for nitrosating agent	Aug. 15

Extraction of Endogenous TSNA Strategy

Testing extraction/TSNA removal/addition process	Aug. 31
Subjectives on cigarettes from extracted fillers	Sept. 30
Perform necessary studies in support of Sepracor program	on-going

TSNA Decomposition Strategy

Conduct smoking experiments with optimized antioxidant levels	Sept. 1
Initiate implementation of homolytic cleavage proposal	Sept. 15

Cigarette Construction Parameter Strategy

Continue evaluation of construction parameters	on-going

FOURTH QUARTER 1988

Amine Precursor Strategy

Evaluate the role of unextracted nicotine in TSNA pyrosynthesis by the following:

Complete analyses of cured, extracted green tobacco	Oct. 15

Continue evaluation of other alkaloids and derivatives which may be precursors:

Complete study of polymeric secondary amines	Dec. 31

Oriental Inhibitor Strategy

Determining the effect of "local" cultivation on chemistry of oriental tobacco:

Initiate curing/fermentation of "locally" cultivated oriental	Sept. 1

Nitrosating Agent Strategy

Initiate quantitative study of effect of nitrate	Oct. 1
Initiate protein study	Oct. 1
Continue study of scavengers for nitrosating agents	on-going
Continue studies outlined in nitrosation proposal	on-going

Extraction of Endogenous TSNA Strategy

Investigate photolysis of TSNA as means of removal from extracting solvents

Using PM equipment	Nov. 15
Using commercially available thin-film reactors	Dec. 15

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TSNA Decomposition Strategy

Characterize decomposition pathway from kinetic/thermodynamic perspective	Initiate
Effect of altered burn temperature on decomposition	Dec. 31
Perform necessary studies in support of Sepracor program	on-going

Cigarette Construction Parameters Strategy

Continue construction parameters studies	Dec. 31

1989

Effect of removal of alkaloid/amines by various processes on MS TSNA
Effect of trace metal content on MS TSNA delivery
Effect of pH of oriental
Complete protein and nitrate study
Initiate studies of role of NO in nitrosation
Completion of nitrosating agent studies
Evaluation of salt effects
Complete construction parameters studies

1990

Construction and evaluation of models based upon studies to date

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RESOURCE ALLOCATIONS FOR 1988

How are the personnel assigned to this program allocated?

Amine Precursor Strategy:	Haut 65% Warfield 15% Kaiser 55% Lambert 10% Kinser 15%
Oriental Inhibitor Strategy:	Morgan 5% Haut 15% Warfield 20% Kinser 10%
Nitrosating Agent Strategy:	Morgan 50% Kaiser 15% Haut 10% Kinser 10%
Extraction of Endogenous TSNA Strategy:	Warfield 60% Tickle 25% Lambert 15% Kinser 10%
Decomposition of TSNA Strategy:	Morgan 35% Tickle 35% Kinser 10%
Cigarette Construction Parameters Strategy:	Lambert 60% Kaiser 15% Kinser 5% Morgan 10%
Adjustments to Filler Salt Content Strategy:	None in 1988

Are there enough people allocated to this program?

At the end of 1987, the number of people allocated to this program was decreased when Kathy Hansen was temporarily assigned to the Project Delta priority program. Since it was predicted that her involvement in Project Delta would continue for at least six months, the plans outlined in this document do not include any contributions from Ms. Hansen, and do not represent the rate of accomplishment that would be possible if Kathy were participating in this work. While an additional Associate Scientist did join the project in mid-October, this individual has little experience with chemical analysis, will not be completely trained until the end of first quarter, 1988, and will probably require close supervision for at least one other quarter. Ms. Hansen's skills in performing accurate analyses, interpreting the data, and communicating the results enabled her to independently perform much of the TSNA support function. This in turn permitted us to provide a high level of support to other R&D programs while continuing the more fundamental research designed to achieve our primary goal of MS TSNA reduction. Obviously, even strict adherence to the plans prepared assuming Ms. Hansen's absence will result in a slower rate of

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progress than would be achieved if Ms. Hansen, who has two years of research experience in this area, were participating in nitrosamine research. A support request from a high priority special program has already been received which requires pushing forward estimated completion dates for some of the 1988 plans. The timetable prepared also eliminated any improvements to the analytical methods currently employed, since this work is typically assigned a lower priority and there were no professionals available to conduct such studies. Due to the uncertainty in length of Ms. Hansen's current assignment, allocation of another professional to this program for the time of her absence would ensure that nitrosamine support functions are performed in a timely manner and that the nitrosamine research program timetable outlined in this document is met. Therefore, I recommend assignment of either an Associate Scientist A or B to this program for the duration of Ms. Hansen's involvement with the Delta priority program.

Also, there is only one full-time technician currently supporting the work of five professionals; until third quarter, 1987, there were two technicians. A technician already in the group is being trained to assist in nitrosamine analyses, but this individual is allocated primarily to the Lowered Biological Activity program and could be utilized less than 20% of the time. An increase in technician support of this program by addition of one Research Lab Technician III is needed.

When these plans were prepared in January of this year, information as to the number of TSNA analyses needed by other priority programs was not readily available. As the year has progressed, several requests have been received from two other priority programs and our colleagues at FTR R&D. Research addressing one strategy as been postponed an entire quarter because there are not enough people currently assigned to the TSNA program to conduct the planned research and address the unplanned support requests.

Are the people allocated to this program the right people in terms of skills?

In terms of skills, the current staffing of this program appears adequate through 1989. Three senior professionals with formal training and years of research experience in organic chemistry and analytical chemistry are assigned to this program. Three (including Ms. Hansen) junior professionals and one technician, all with significant on-the-job training in the appropriate analytical methods, capably assist in the fundamental research programs and perform analyses requested by colleagues in other parts of R&D.

Are there special equipment and facilities and/or outside expertise required?

Other than the specialized analytical equipment already in our laboratories, the only other special equipment we foresee needing is available in the supercritical fluid extraction facility in the Physical Research Division. Outside consultants in the area of nitrosation chemistry and/or N-N bond cleavage may be needed; the decision is dependent upon the results of literature searches planned for 1988.

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IMPACT ON OTHER AREAS BOTH WITHIN AND OUTSIDE R&D

Research described in this plan will require specific assistance from the Analytical Research Division and the Physical Research Division. For 1988, requests to Analytical should require 0.25 to 0.5 man-months to complete. Extractions to be requested from the Physical Research Division's supercritical fluid facility during 1988 also should be completed within 0.5 man-months. Ultimately machine-made cigarettes will be required for evaluation, but that will probably not be until 1990. Assistance and training from individuals more skilled in cigarette design than anyone currently working in this area will be required when model construction and evaluation becomes the primary task of this group.

ACKNOWLEDGMENTS

The following participants in the nitrosamine research program contributed to this planning process: K. Hansen, S. Haut, R. Kaiser, E. Lambert, R. Morgan, M. Tickle, and A. Warfield.

cc: Dr. J. L. Charles
Dr. E. B. Sanders

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Lowered Biological
Activity

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PHILIP MORRIS U. S. A.

RESTRICTED DISTRIBUTION

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .Distribution

Date: November 9, 1988

From: .Mike Penn

Subject: .Third Quarter Update of the LBA Program

You are invited to the Lowered Biological Activity Program update on Tuesday, November 29, 1988, in A1 conference room from 1:00 a.m. to 4:00. Elizabeth Mooz will also present an update on the Alternate Humectant Program.

I.	Bioassay Development	
	A. Epidermal Growth Factor Binding Assay (G. Patskan)	1:00-1:20
	B. Inhibition of PDBu Binding (T. Burruss)	1:20-1:30
	C. PKC Activity in Intact Cells (G. Nixon)	1:30-1:45
II.	Model Evaluation	
	A. Salmonella/microsome Assay (L. Thompson)	1:45-2:00
	Break (15 min)	2:00-2:15
	B. Glutathione Depletion Assay (B. McCoy)	2:15-2:35
III.	Model Development - Crossed Solubles/Base Web Study (D. Magin and D. Williams)	2:35-2:55
IV.	Model Optimization - Reduction of Nitric Oxide in Smoke (R. Levins)	2:55-3:00
V.	Alternate Humectant Program (Elizabeth Mooz)	3:00-3:30

Distribution

BCR Division
J. Charles
R. Izac
C. Lilly
D. Magin
E. Sanders
D. Williams

Mike Penn

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

RESTRICTED DISTRIBUTION

To: .Dr. R. W. McCuen Date: November 2, 1988

From: .Mike Penn

Subject: .Operational Plans for the Lowered Biological Activity Program Updated from the Third Quarter Planning Meeting

I. OBJECTIVE

To decrease the activity of cigarette smoke condensate (CSC) by 90% as determined by in vitro assays.

II. STRATEGIES

The strategy for achieving a lowered biological activity condensate involves the development and use of in vitro assays to determine which cigarette modifications significantly reduce CSC activity. The Salmonella/microsome (S/M) assay has adequately served as a test system for the detection of initiators (DNA damage) and virtually all routine evaluations of CSC have been conducted in this test. Another aspect of the effects of CSC concerns the interference with the biological defense mechanisms. The glutathione depletion assay (GDA) measures the depletion of the thiol, glutathione, caused by CSC. In order to make rational decisions regarding the reduction of CSC activity, a test system is needed for the detection of promoters (CSC has been shown to be a moderate promoter). Therefore, a major effort of this program involves the development of a promoter assay.

III. BACKGROUND

Research toward achieving a low biological activity condensate consists of bioassay development, model development, model evaluation, and model optimization. Bioassay development consists of developing a suitable in vitro assay that can clearly differentiate the activity among a series of model cigarettes. The S/M assay is extensively used in the model development phase in which various solubles on base web have been modified by a variety of methods. Model evaluation involves testing in the S/M assay and the GDA the activity of CSCs obtained from new types of cigarette models. Model optimization, to date, is concerned with determining the chemical components responsible for the poor subjectives of low activity model cigarettes.

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IV. Status and Plans

A. Bioassay Development

1. Epidermal Growth Factor Assay

a. Status:

Different CSCs showed similar levels of inhibition of EGF binding. The acid, base, and neutral fractions of CSC were active.

Catechol may be a major contributor to the effects of CSC in the EGF binding assay.

b. Plans:

1. Prepare catechol-depleted CSC (Dec. 31, 1988).

2. Determine catechol's effect on EGF receptors (Nov 30, 1988).

3. Supplement CSC with catechol (Dec. 31, 1988).

2. Inhibition of PDBu Binding

a. Status:

Both CSC and catechol increased PDBu binding. Different CSCs produced similar increases in PDBu binding.

b. Plans:

1. Determine CSC effects on the affinity and number of receptors (Nov. 30, 1988).

2. Determine the feasibility of conducting PDBu experiments in conjunction with the EGF assay (Dec. 31, 1988).

3. Protein Kinase C Assay (Intact Cells)

a. Status:

A number of assay conditions (treatment time, culture growth phase) were established. TPA and CSC were both active in this assay. Catechol was inactive.

b. Plans:

1. Complete the dose-response of CSC (Oct. 30, 1988).

2. Compare frozen versus fresh CSC (Dec. 31, 1988).

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3. Draft a memo pertaining to quantitation of assay responses (Dec. 31, 1988).

B. Model Development

1. Status:

Samples for fractionation have been completed. These include centrifugation of BuCEL and BuCEL solubles retained and passed through a 1000 MW membrane.

2. Plans:

a. Prepare soluble/insoluble fractions from Br and OR CELs (Nov. 15, 1988).

b. Prepare cigarettes from Br and OR insoluble CEL fractions (Dec., 1988).

c. Examination BuCEL solubles using HPLC (Dec., 1988).

d. Investigate effect of protein addition on Br CEL/BrBW (Dec., 1988).

C. Model Evaluation

1. Salmonella/microsome Assay

a. Status:

Investigated the effect of calcium acetate on crossed soluble/base web samples. The results indicated that: 1) as % Ca++ increased, CSC yields decreased; 2) Ca++ added to BW alone did not produce a significant increase in S/M IT CSC S.A. except at the higher (6-7%) Ca++ levels; 3) BuCEL + BrBW with added Ca++ produced CSCs with higher S.A.s; however, the differences were not significant in all cases; 4) there was no distinct pattern to indicate a concentration/response of added Ca++ in regards to S/M activity; and 5) as the amount of added BuCEL increased, S/M activity generally increased.

b. Plans:

1. Evaluate membrane filtered BuCEL solubles (Oct. 31, 1988).

2. Test BuCEL insolubles (Nov. 30, 1988).

3. Evaluate additional samples to complete the calcium acetate study (Dec., 1988).

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2. Glutathione Depletion Assay (GDA)

a. Status:

GSH depletion in Salmonella cells by DEM or CSC did not increase 2NF activity.

b. Plans:

1. Test CDNB in place of 2NF in S/M experiment (Nov. 30, 1988).

2. Evaluate HCN in the GDA (Dec. 31, 1988).

3. Test whole smoke/gas phase filler (as time permits).

D. Model Optimization

1. Status:

Experiments were conducted to optimize a method for quantitating NO in smoke.

2. Plans:

a. Investigate the effect of spraying a diene generator on filler (Dec., 1988).

b. Investigate effect of oxidation of NO to NO_2 and then remove NO_2 with phenoxide ions (Dec., 1988).

V. Resource Allocations

BIOASSAY DEVELOPMENT:

EFG Assay

G. Patskan (80%)
B. Vaughan (30%)
B. Davies (10%)
M. Penn (10%)

PDBu Assay

T. Ferguson (100%)
G. Patskan (20%)
M. Penn (10%)
B. Davies (10%)

Protein Kinase C Activity in Intact Cells

G. Nixon (100%)
B. Davies (15%)
M. Penn (10%)

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MODEL EVALUATION

S/M Assay

L. Thompson (100%)
R. Jones (100%)
S. Nolan (Part-time temp.) (100%)
M. Penn (10%)

GDA

B. McCoy (100%)
B. Vaughan (40%)

Smoke and Sample Preparation

R. Hellams (40%)
N. McGee (45%)
A. Warfield (5%)

MODEL DEVELOPMENT

Crossed Solubles/Base Web Study

D. Williams (25%)
D. Magin (25%)
S. Hassam (25%)
R. Izac (20%)

Smoke and Sample Preparation

R. Hellams (40%)
N. McGee (45%)
A. Warfield (10%)

MODEL OPTIMIZATION

Carbonyls and NO_x

B. Levins (65%)
A. Warfield (10%)

Mike Lear

cc: J. Charles
C. Ellis
R. Hellams
W. Hempfling
R. Izac
R. Kinser
C. Lilly
D. Magin
N. McGee
E. Sanders
D. Williams
Project 6906

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CONFIDENTIAL

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

PERSONAL & CONFIDENTIAL

Richmond, Virginia

To: Mr. A. C. Lilly **Date:** July 27, 1988

From: C. Ellis and M. Penn

Subject: Operational Plans for the Lowered Biological Activity Program Updated from Second Quarter Planning Meeting

OBJECTIVE: To decrease the biological activity of cigarette smoke condensate (CSC) by 90% as determined by in vitro assays by a target date of 1992.

BACKGROUND AND STATUS: Based on information in the literature, biological activity can be divided into several stages: initiation, promotion, and conversion. In addition, various biochemical factors may modulate the activity of a substance. The strategies used in the Lowered Biological Activity Program have been to: obtain information on which stage(s) may be important to the activity of CSC; develop in vitro bioassays to quantitatively measure CSC activity; evaluate cigarette models in the assays to obtain background information; develop and test models which are reduced in activity; and optimize the subjectives of a low activity model.

After many years of investigating assays for their ability to detect initiation activity, the Salmonella/microsome (S/M) assay was determined to provide the best information for our purposes. In addition, the S/M assay is the most widely used and accepted in vitro bioassay in the scientific community. The S/M assay is currently being used in the Crossed Solubles/Base Web Study to develop model cigarettes with reduced activity. Feedstock, base web, and all possible RL combinations of the solubles and base webs were made from burley, bright and oriental tobacco. Extensive analytical data have been obtained in these models and, based on this information, modifications have been made to the solubles by a variety of methods. The effect of these modifications on activity is evaluated by spraying the solubles onto the base web, fabricating cigarettes, and testing the CSC in the S/M assay. Significant reductions in activity have been obtained with various modifications to the CEL and an active research program is planned in this area.

Based on the lower S/M activity models that have been developed, work will need to be done to improve the subjectives of these cigarettes. Studies involving the optimization of low activity models have concentrated on the reduction of carbonyls in smoke. This work has been successful and future studies will focus on the reduction of NO_x in smoke.

The Glutathione Depletion Assay (GDA) is a biochemical endpoint that is utilized to evaluate the effect of CSC on glutathione depletion. Glutathione (GSH) is a low molecular weight thiol that is important to normal cellular functions and biological defense mechanisms. Depletion of GSH has been demonstrated to produce an increase in the activity of a positive control

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compound in the S/M assay. Plans in this area include the evaluation of a variety of models and the isolation and identification of substances in CSC that are responsible for GSH depletion.

The development of a promotion assay for CSC continues to be a key goal of the Lowered Biological Activity Program. The central focus of the potential promotion assays under development is the enzyme protein kinase C (PKC) which can modulate cell physiology and biochemistry via the phosphorylation of cellular proteins. The two binding assays that are currently being investigated are the epidermal growth factor (EGF) binding assay and the phorbol 12, 13 - dibutyrate (PDBu) binding assay. The results obtained with the EGF assay indicate that CSC obtained from several cigarette models can inhibit EGF binding to its receptor. Investigations regarding the assay's ability to differentiate among selected CSCs are in progress. Optimization of assay parameters and kinetic studies for the PDBu binding assay have been completed. Experiments have been conducted with CSC and the results indicate that 2R1 CSC stimulates the binding of PDBu. Two additional assays are being investigated for their ability to measure the effect of CSC on protein kinase C in cell fractions and intact cells.

Because some aspects of biological activity are poorly understood and are the subject of intense investigation in the scientific community, additional leads may become available to us at any time. New information could drastically affect our plan. We intend to monitor the literature very closely and make modifications to the program when the evidence warrants a change.

STRATEGIES:

1. INFORMATION SURVEY: maintain an awareness of scientific advances related to the understanding of biological activity and the implication of a role for CSC.

2. BIOASSAY DEVELOPMENT: develop suitable in vitro bioassays which can clearly differentiate among a series of model cigarettes.

3. MODEL EVALUATION: determine the activity of smoke condensate from various types of cigarette models in order to obtain background information from which to design modifications.

4. MODEL DEVELOPMENT: perform modifications to various cigarette parameters to reduce activity and formulate new models.

5. MODEL OPTIMIZATION: improve the subjectives of a low activity model.

TACTICS AND TIMETABLE:

OPERATIONAL PLANS FOR 1988

I. BIOASSAY DEVELOPMENT

A. Epidermal Growth Factor Binding Assay

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Third Quarter 1988
1. Determine effect of removing catechol from CSC. (August 1)
2. Compare EGF from Amersham and Collaborative. (August 1)
3. Complete time course and fraction study. (August 1)

Fourth Quarter 1988
1. Test catechol depleted CSC and fractions. (October 1)
2. Using the EGF assay, investigate the activity of other classes of promoters. (October 1)
3. Begin to examine the pathway through which CSC inhibits EGF binding to aid in the development of a biochemical assay. (October 1)

Decision Point on EGF Assay: December 1988

B. Inhibition of Phorbol 12,13 -Dibutyrate (PDBu) Binding

Third Quarter 1988
1. Examine the effect of CSC on the affinity and number of PKC receptors. (July 31)
2. Examine effect of other CSCs. (August 31)
3. Examine effect of catechol on affinity and number of receptors. (September 30)

Fourth Quarter 1988
1. Examine possible synergistic effects. (October 31)

Decision Point on PDBu Assay: December 1988

C. Protein Kinase C (PKC) Activity Assay

Decision Point Reached:
Assay discontinued due to variability and high solvent background.

D. Protein Kinase C Quantitation Assay
Utilize an antibody to quantitate enzyme levels/location.

Third Quarter 1988
1. Complete development/optimization of techniques. (July 31)
2. Utilize antibody to quantitate enzyme levels and location. (August 31)
3. Examine effect of CSC. (September 31)

Decision Point on the PKC Quantitation Assay: December 1988

E. Protein Kinase C Activity in Intact Cells

Third Quarter 1988
1. Complete a preliminary investigation of the effects of CSC. (July 31)
2. Investigate the utilization of an antibody against phosphorylated tyrosine as another means of quantitating PKC activity. (September 30)

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Fourth Quarter 1988

1. Determine effect of a promoter and CSC on phosphorylation of existing and newly synthesized proteins. (November 30)
2. Perform complete study on CSC and fractions. (Begin December 1)

First Quarter 1989

1. Perform additional experiments as needed on CSCs or fractions. (1989)

Decision Point on the PKC Activity Assay in Intact Cells: Second Quarter 1989

II. MODEL EVALUATION

A. Salmonella/microsome (S/M) Assay

Third Quarter 1988

1. Investigate effect of sugar-chlorogenic acid or sugar-caffeic acid complexes on 2R1 CSC activity. (September 30)
2. Evaluate other models and submitted samples. (ongoing)

B. Glutathione Depletion Assay (GDA)

Third Quarter 1988

1. Determine of effects of GSH depletion by CSC on activity measured in the S/M assay. (Complete September 30)

Fourth Quarter 1988

1. Evaluate the activity of HCN in the GDA. (November 15)
2. Begin isolation and identification of GSH-CSC adducts. (November 15)

III. MODEL DEVELOPMENT

A. Crossed Solubles/ Base Web Study

Third Quarter 1988

1. Complete investigation of the effect of monovalent and divalent cations. (July 15)
2. Complete ultrafiltration study. (July 31)
3. Determine the effect of CEL insolubles on activity. (August 31)
4. Complete ion exchange study:
   a. Generate additional material for extensive analysis. (August 31)
   b. Investigate effect of anion exchange resin. (September 30)
   c. Investigate effect of other ion exchange materials (Sepracor, other resins). (on-going)

Fourth Quarter 1988

1. Determine the effect of electrodialysis on the activity of tobacco solubles. (October 31)
2. Begin investigation of effects of nitrogenous compounds on

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activity (amino acids, proteins, nitrate). (Begin September)

3. Begin to investigate the effects of combining various modifications. (December 1)

IV. MODEL OPTIMIZATION
DECREASE LEVELS OF NO_x IN SMOKE

Third Quarter 1988

1. Optimize quantitative method for determining NO levels in smoke. (July 15)
2. Investigate effect of spraying a diene generator (vitamin A derivative, squalene, neophytadiene) onto filler on smoke NO levels. (August 31)
3. Investigate effect of oxidation of NO to NO_2 and then removal of NO_2 with phenoxide ions via charge transfer. (September 30)

EXTENDED PLANS:

BIOASSAY DEVELOPMENT:

1989: Begin to investigate other biochemical endpoints and techniques (mouse epidermal cell cultures, free radical mechanisms, intracellular calcium). Investigate other endpoints as evidence warrants. Begin to develop flow cytometry techniques.

1990: Utilize Flow Cytometry to increase our sensitivity, efficiency, and capabilities with regard to in vitro bioassays.

1991: Develop an assay for promotion activity. Investigate the activity of CSC in assays measuring activity in other stages of Biological Activity.

MODEL EVALUATION:

1989-1992: Continue to evaluate models as needed.

MODEL DEVELOPMENT:

1989-1990: Combine all effective modifications to obtain a low activity model for the S/M assay. Begin extensive testing. Begin flavor work.

1991: Begin the development of low promotion activity models.

MODEL OPTIMIZATION:

1989-1990: Optimize the subjectives of a low S/M activity model.

1991: Begin work on optimizing the subjectives of a low promotion activity model.

RESOURCE ALLOCATIONS FOR 1988:

Personnel Allocations:

INFORMATION SURVEY: Responsibility of all Professionals

BIOASSAY DEVELOPMENT:

M. Penn, Research Scientist, Project Leader(40%)
B. Davies, Research Scientist (60%)

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G. Nixon, Scientist (100%)
G. Patskan, Scientist (100%)
D. Stagg, T4 (on special assignment)
T. Burruss, T3 (100%)
B. Vaughan, T3 (80%)

MODEL EVALUATION:

S/M Assay:
L. Thompson, Scientist (100%)
S. Coleman, T3 (60%)
C. Deubler, Temp (50%)
B. Vaughan, T3 (5%)
M. Penn, Research Scientist, Project Leader (10%)

GDA:
B. McCoy, Research Scientist (100%)
M. Penn, Research Scientist, Project Leader (10%)
B. Vaughan, T3 (15%)

Smoke and Sample Preparation:
R. Hellams, Research Scientist (40%)
N. McGee, T2 (45%),
R. Kinser, Research Scientist, Project Leader (5%)

MODEL DEVELOPMENT:

Crossed Solubles/Base Web Study:
D. Williams, Research Scientist (25%)
D. Magin, Research Scientist (80%)
S. Coleman, T3 (25%)

Smoke and Sample Preparation:
R. Hellams, Research Scientist (40%)
N. McGee, T2 (45%)
R. Kinser, Research Scientist, Project Leader (5%)

MODEL OPTIMIZATION:

NO_x:
R. Levins, Associate Senior Scientist (65%)
R. Kinser, Research Scientist, Project Leader (10%)

Number of People:

There are needs in the following areas:

1. A replacement for D. Stagg (T4) who is on special assignment.
2. A Chemist (replacement for David Williams/Don Magin who was on loan to us from Chemical Research/ARD) with some biology experience (Scientist or above) who can perform the following: crossed soluble/base web modifications and separations; coordinate model optimization (flavors), assist with the isolation and identification of GSH adducts, provide general assistance and chemical expertise to the Lowered Biological Activity Program.
3. A Chemist (Associate B level) who can assist in model development: the preparation of model cigarettes, spraying filler with modified CEL or other substances of interest, preparing cigarettes, preparing LTF formulations, and performing chemical analyses on filler and smoke. The individual would

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work with R. Hellams and assist in research programs on the effect of filtration and smoking parameters on biological activity.

Anticipated need in 1989 is:

1. An individual with experience in flow cytometry. This relatively new technique could greatly enhance the sensitivity, efficiency, and capability of our bioassays and would impact Bioassay Development and other related areas of research. It is estimated that we could utilize these skills in 1989. A thorough review of the capabilities of this technique will be made in 1988 and an extensive justification will be written.

Skills of People:

See above.

Special Equipment and Facilities:

A Flow Cytometer (about $500K) could be utilized in 1989. This piece of equipment would have a significant impact on the sensitivity, efficiency, and capabilities of much of the biology/biochemistry related work. A thorough justification will be developed in 1988.

Outside Expertise:

Occasional antibody work may need to be performed.

Impact on Other Areas of PM:

1988:
Analytical Research: 200 man hours/year
Cigarette Testing: 30 man hours/year
Pilot Plant: 2 weeks every two years
Semiworks: approximately 1/2 day/year
Library
CAD

Extended:
Chemical Research: flavor development, beginning in 1989
NMR/MS(probably LC or FAB): for the isolation and identification of glutathione-CSC adducts, beginning in 1989
Flavor Development: assistance beginning in 1990

cc: J. L. Charles
W. P. Hempfling
R. D. Kinser
R. W. McCuen
E. B. Sanders
A. H. Warfield

2021555776

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

CONFIDENTIAL

PERSONAL & CONFIDENTIAL

To: Mr. A. C. Lilly **Date:** April 20, 1988

From: C. Ellis and M. Penn

Subject: Operational Plans for the Lowered Biological Activity Program

OBJECTIVE: To decrease the biological activity of cigarette smoke condensate (CSC) by 90% as determined by in vitro assays by a target date of 1992.

BACKGROUND AND STATUS: Based on information in the literature, biological activity can be divided into several stages: initiation, promotion, and conversion. In addition, various biochemical factors may modulate the activity of a substance. The strategies used in the Lowered Biological Activity Program have been to: obtain information on which stage(s) may be important the activity of CSC; develop in vitro bioassays to quantitatively measure CSC activity; evaluate cigarette models in the assays to obtain background information; develop and test models which are reduced in activity; and optimize the subjectives of a low activity model.

After many years of investigating assays for their ability to detect initiation activity, the Salmonella/microsome (S/M) assay was determined to provide the best information for our purposes. In addition, the S/M assay is the most widely used and accepted in vitro bioassay in the scientific community. The S/M assay is currently being used in the Crossed Solubles/Base Web Study to develop model cigarettes with reduced activity. Feedstock, base web, and all possible RL combinations of the solubles and base webs were made from burley, bright and oriental tobacco. Extensive analytical data have been obtained in these models and, based on this information, modifications have been made to the solubles by a variety of methods. The effect of these modifications on activity is evaluated by spraying the solubles onto the base web, fabricating cigarettes, and testing the CSC in the S/M assay. Significant reductions in activity have been obtained with various modifications to the CEL and an active research program is planned in this area.

Based on the lower S/M activity models that have been developed, work will need to be done to improve the subjectives of these cigarettes. Studies involving the optimization of low activity models have concentrated on the reduction of carbonyls in smoke. This work has been successful and future studies will focus on the reduction of NO_x in smoke.

The Glutathione Depletion Assay (GDA) is a biochemical endpoint that is utilized to evaluate the effect of CSC on glutathione depletion. Glutathione (GSH) is a low molecular weight thiol that is important to normal cellular functions and biological defense mechanisms. Depletion of GSH has been demonstrated to produce an increase in the activity of a positive control

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compound in the S/M assay. Plans in this area include the evaluation of a variety of models and the isolation and identification of substances in CSC that are responsible for GSH depletion.

The development of a promotion assay for CSC continues to be a key goal of the Lowered Biological Activity Program. The central focus of the potential promotion assays under development is the enzyme protein kinase C (PKC) which can modulate cell physiology and biochemistry via the phosphorylation of cellular proteins. The two binding assays that are currently being investigated are the epidermal growth factor (EGF) binding assay and the phorbol 12, 13 - dibutyrate (PDBu) binding assay. The results obtained with the EGF assay indicate that CSC obtained from several cigarette models can inhibit EGF binding to its receptor. Investigations regarding the assay's ability to differentiate among selected CSCs are in progress. Optimization of assay parameters and kinetic studies for the PDBu binding assay have been completed. Experiments are now being conducted to obtain a positive response with IT 2R1 CSC. Two additional assays are being investigated for their ability to measure the effect of CSC on protein kinase C in cell fractions and intact cells.

Because some aspects of biological activity are poorly understood and are the subject of intense investigation in the scientific community, additional leads may become available to us at any time. New information could drastically affect our plan. We intend to monitor the literature very closely and make modifications to the program when the evidence warrants a change.

STRATEGIES:

1. INFORMATION SURVEY: maintain an awareness of scientific advances related to the understanding of biological activity and the implication of a role for CSC.

2. BIOASSAY DEVELOPMENT: develop suitable in vitro bioassays which can clearly differentiate among a series of model cigarettes.

3. MODEL EVALUATION: determine the activity of smoke condensate from various types of cigarette models in order to obtain background information from which to design modifications.

4. MODEL DEVELOPMENT: perform modifications to various cigarette parameters to reduce activity and formulate new models.

5. MODEL OPTIMIZATION: improve the subjectives of a low activity model.

TACTICS AND TIMETABLE:

OPERATIONAL PLANS FOR 1988

I. BIOASSAY DEVELOPMENT

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

A. Epidermal Growth Factor Binding Assay

First Quarter 1988
1. Determine the effect of cell density on EGF binding. (February 1)
2. Begin to evaluate the effects of CSC fractions on EGF binding. (March 1)

Second Quarter 1988
1. Examine the time course of the CSC effect. (June 1)
2. Complete the evaluation of CSC fractions. (June 30)
3. Test CSCs from other model cigarettes. (June 30)

Third Quarter 1988
1. Determine effect of removing catechol from CSC. (August 1)
2. Using the EGF assay, investigate the activity of other classes of promoters. (September 1)
3. Begin to examine the pathway through which CSC inhibits EGF binding to aid in the development of a biochemical assay. (Begin September 1)

Decision Point on EGF Assay: December 1988

B. Inhibition of Phorbol 12,13 -Dibutyrate (PDBu) Binding

First Quarter 1988
1. Obtain a response with 2R1 CSC. (March 1)

Second Quarter 1988
1. Optimize the response and determine the quantitative properties of the assay. (May 1)
2. Examine the effects of two model CSCs and catechol. (June 30)

Third Quarter 1988
1. Examine the effect of CSC on the affinity and number of PKC receptors. (July 1)

Decision Point on PDBu Assay: September 1988

C. Protein Kinase C (PKC) Activity Assay

First Quarter 1988
1. Examine the effect of CSC on the basal levels of the enzyme (time course and dose response experiments). (March 31)

Second Quarter 1988
1. Examine the effect of CSC on stimulated levels of the enzyme. (April 15)

Decision point on the PKC Activity Assay: April 1988

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D. Protein Kinase C Quantitation Assay

Second Quarter 1988
1. Develop immunochemical techniques required for these analyses. (June 30)

Third Quarter 1988
1. Utilize an antibody to quantitate enzyme levels/location. (September 1)

Decision Point on the PKC Quantitation Assay: September 1988

E. Protein Kinase C Activity in Intact Cells

First Quarter 1988
1. Begin to optimize assay conditions to obtain a positive response with TPA. (Complete May 31)

Second Quarter 1988
1. Develop methods for quantitation (obtain appropriate software). (June 30)
2. Determine the effects of pre or post labeling with a promoter. (June 30)
3. Examine the labeling patterns of 3T3 cells with the PhastSystem using a variety of cell conditions (logarithmic, confluent, and serum-deprived) (June 30)

Third Quarter 1988
1. Complete a preliminary investigation of the effects of CSC. (October 1)

Fourth Quarter 1988
1. Perform additional experiments as needed on CSCs or fractions. (December 31)

Decision Point on the PKC Activity Assay in Intact Cells: December 1988

II. MODEL EVALUATION

A. Salmonella/microsome (S/M) Assay

First Quarter 1988
1. Evaluate the effects of filters (charcoal, THAM, basic alumina) on the S/M activity of washed shredded bright stem and BCR blend cigarettes. (March 1)

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B. Glutathione Depletion Assay (GDA)

First Quarter 1988
1. Begin a literature search on the isolation and identification of GSH adducts. (February 1)

Second Quarter 1988
1. Evaluate the gas phase and whole smoke of BCR blend cigarettes with whistle through, THAM on charcoal, and basic alumina filters. (Complete May 30)

Third Quarter 1988
1. Determine of effects of GSH depletion by CSC on activity measured in the S/M assay. (Complete August 30)
2. Evaluate the activity of HCN in the GDA. (September 30)

Fourth Quarter 1988
1. Begin isolation and identification of GSH-CSC adducts. (October 30)

III. MODEL DEVELOPMENT

A. Crossed Solubles/ Base Web Study

First Quarter 1988
1. Compile and issue a report containing analytical data. (Complete April 30)
2. Begin an examination of the effect of ultrafiltration and size exclusion techniques. (January 1)
3. Begin an examination of selective ion exchange resins. (January 1)
4. Begin investigation of the effects of monovalent and divalent cations. (February 1)

Second Quarter 1988
1. Complete survey study of ultrafiltration and size exclusion techniques. (May 1)
2. Complete survey study of ion exchange resins. (June 1)

Third Quarter 1988
1. Begin investigation of effects of nitrogenous compounds on activity (amino acids, proteins, nitrate). (July 1)
2. Complete investigation of the effect of monovalent and divalent cations. (September 1)

Fourth Quarter 1988
1. Investigate the effect of sugar-chlorogenic acid or sugar-caffeic acid complexes on activity. (December 1)
2. Begin to investigate the effects of combining various modifications. (December 1)
3. Determine the effect of CEL insolubles on activity. (December 31)

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IV. MODEL OPTIMIZATION

A. Carbonyl Reduction

First Quarter 1988

1. Evaluate the selective reduction of both formaldehyde and acrolein. (February 15)

B. NO_x Reduction

First Quarter 1988

1. Complete a literature search. Obtain and evaluate necessary papers. (March 15)

Second Quarter 1988

1. Investigate and establish analytical procedures suitable for NO_x determination in MS smoke. (May 30)
2. Design prototype filters for the reaction/adsorption of NO_x. Evaluate the effect of diene generators (via pyrolysis). (June 30)

EXTENDED PLANS:

BIOASSAY DEVELOPMENT:

1989: Begin to investigate other biochemical endpoints and techniques (mouse epidermal cell cultures, free radical mechanisms, intracellular calcium). Investigate other endpoints as evidence warrants. Begin to develop flow cytometry techniques.
1990: Utilize Flow Cytometry to increase our sensitivity, efficiency, and capabilities with regard to in vitro bioassays.
1991: Develop an assay for promotion activity. Investigate the activity of CSC in assays measuring activity in other stages of Biological Activity.

MODEL EVALUATION:

1989-1992: Continue to evaluate models as needed.

MODEL DEVELOPMENT:

1989-1990: Combine all effective modifications to obtain a low activity model for the S/M assay. Begin extensive testing. Begin flavor work.
1991: Begin the development of low promotion activity models.

MODEL OPTIMIZATION:

1989-1990: Optimize the subjectives of a low S/M activity model.
1991: Begin work on optimizing the subjectives of a low promotion activity model.

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RESOURCE ALLOCATIONS FOR 1988:

Personnel Allocations:

INFORMATION SURVEY: Responsibility of all Professionals

BIOASSAY DEVELOPMENT:
EGF Assay- G. Patskan(100%), D. Stagg(100%), B. Davies(10%), M. Penn (10%)
PDBu Assay- T. Ferguson(100%), B. Davies (20%), M. Penn (10%)
Protein Kinase C Activity- B. Vaughan(60%), B. Davies(20%), M. Penn(10%)
Protein Kinase C Activity in Intact Cells- G. Nixon(100%), B. Davies(15%), M. Penn(10%)
Collen Deubler assists part-time in all of the above(25%).

MODEL EVALUATON:
S/M Assay- L. Thompson(100%), S. Coleman(75%), C. Deubler(50%), M. Penn(10%)
GDA- B. McCoy(100%), B. Vaughan(40%)
Smoke and Sample Preparation: R. Hellams(40%), N. McGee(45%), R. Kinser (5%)

MODEL DEVELOPMENT:
Crossed Solubles/Base Web Study: D. Williams (25%), S. Coleman (25%)
Smoke and Sample Preparation: R. Hellams(40%), N. McGee(45%), R. Kinser (5%)

MODEL OPTIMIZATION:
Carbonyls and NO_x: B. Levins(65%), R. Kinser (10%)

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Number of People:

There are immediate needs in the following areas:

1. A replacement for D. Stagg (T4) who is on special assignment. It is imperative that this person would require little training and have experience with sterile technique, mammalian cell culture, and handling radioactive materials. Due to the nature of our work, the use of a temporary employee in this area is not feasible. Because of the anticipated time frame involved, utilizing a technician who will require a significant amount of training would not provide us with an adequate return on our training investment. The feasibility of obtaining a qualified person from another area and replacing that person with a temp has been explored. Neither Bob McCuen nor Dick Cox had a T4-level individual with the appropriate qualifications. Based on this information and the uncertainty surrounding the duration of Ms. Stagg's assignment, I recommend that a full-time technician be hired to assist us in this area. Failure to do so will have a negative impact on the schedules outlined in this document.

2. A Chemist (replacement for David Williams who was on loan to us from Chemical Research) with some biology experience (Scientist or above) who can perform the following: crossed soluble/base web modifications and separations; coordinate model optimization (flavors), assist with the isolation and identification of GSH adducts, provide general assistance and chemical expertise to the Lowered Biological Activity Program.

3. A Chemist (Associate B level) who can assist in model development: the preparation of model cigarettes, spraying filler with modified CEL or other substances of interest, preparing cigarettes, preparing LTF formulations, and performing chemical analyses on filler and smoke. The individual would work with R. Hellams and assist in research programs on the effect of filtration and smoking parameters on biological activity.

Anticipated need in 1989 is:

1. An individual with experience in flow cytometry. This relatively new technique could greatly enhance the sensitivity, efficiency, and capability of our bioassays and would impact Bioassay Development and other related areas of research. It is estimated that we could utilize these skills in 1989. A thorough review of the capabilities of this technique will be made in 1988 and an extensive justification will be written.

Skills of People:

See above.

Special Equipment and Facilities:

A Flow Cytometer (about $500K) could be utilized in 1989. This piece of equipment would have a significant impact on the sensitivity, efficiency, and capabilities of much of the biology/biochemistry related work. A thorough justification will be developed in 1988.

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Outside Expertise:

Occasional antibody work may need to be performed.

Impact on Other Areas of PM:

1988:
Analytical Research: 200 man hours/year
Cigarette Testing: 30 man hours/year
Pilot Plant: 2 weeks every two years
Semiworks: approximately 1/2 day/year
Library
CAD

Extended:
Chemical Research: flavor development, beginning in 1989
NMR/MS(probably LC or FAB): for the isolation and identification of glutathione-CSC adducts, beginning in 1989
Flavor Development: assistance beginning in 1990

cc: J. L. Charles
W. P. Hempfling
R. D. Kinser
R. W. McCuen
E. B. Sanders

M. Penn
Cathy Ellis

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

PERSONAL & CONFIDENTIAL

To: Dr. J. L. Charles **Date:** February 26, 1988

From: C. Ellis and M. Penn

Subject: Operational Plans for the Lowered Biological Activity Program

OBJECTIVE: To decrease the biological activity of cigarette smoke condensate (CSC) by 90% as determined by in vitro assays by a target date of 1992.

BACKGROUND AND STATUS: Based on information in the literature, biological activity can be divided into several stages: initiation, promotion, and conversion. In addition, various biochemical factors may modulate the activity of a substance. The strategies used in the Lowered Biological Activity Program have been to: determine which stage(s) may be important the activity of CSC; develop in vitro bioassays to quantitatively measure CSC activity; evaluate cigarette models in the assays to obtain background information; develop and test models which are reduced in activity; and optimize the subjectives of a low activity model.

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Based on the lower S/M activity models that have been developed, work will need to be done to improve the subjectives of these cigarettes. Studies involving the optimization of low activity models have concentrated on the reduction of carbonyls in smoke. This work has been successful and future studies will focus on the reduction of NO_x in smoke.

The Glutathione Depletion Assay (GDA) is a biochemical endpoint that is utilized to evaluate the effect of CSC on glutathione depletion. Glutathione (GSH) is a low molecular weight thiol that is important to normal cellular functions and biological defense mechanisms. Depletion of GSH has been demonstrated to produce an increase in the activity of a positive control

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compound in the S/M assay. Plans in this area include the evaluation of a variety of models and the isolation and identification of substances in CSC that are responsible for GSH depletion.

The development of a promotion assay for CSC continues to be a key goal of the Lowered Biological Activity Program. The central focus of the potential promotion assays under development is the enzyme protein kinase C (PKC) which can modulate cell physiology and biochemistry via the phosphorylation of cellular proteins. The two binding assays that are currently being investigated are the epidermal growth factor (EGF) binding assay and the phorbol 12, 13 - dibutyrate (PDBu) binding assay. The results obtained with the EGF assay indicate that CSC obtained from several cigarette models can inhibit EGF binding to its receptor. Investigations regarding the assay's ability to differentiate among selected CSCs are in progress. Optimization of assay parameters and kinetic studies for the PDBu binding assay have been completed. Experiments are now being conducted to obtain a positive response with IT 2R1 CSC. Two additional assays are being developed to measure the effect of CSC on protein kinase C in cell fractions and intact cells.

Because some aspects of biological activity are poorly understood and are the subject of intense investigation in the scientific community, additional leads may become available to us at any time. New information could drastically affect our plan. We intend to monitor the literature very closely and make modifications to the program when the evidence warrants a change.

STRATEGIES:

1. BIOASSAY DEVELOPMENT: develop suitable in vitro bioassays which can clearly differentiate among a series of model cigarettes.

2. MODEL EVALUATION: determine the activity of smoke condensate from various types of cigarette models in order to obtain background information from which to design modifications.

3. MODEL DEVELOPMENT: perform modifications to various cigarette parameters to reduce activity and formulate new models.

4. MODEL OPTIMIZATION: improve the subjectives of a low activity model.

TACTICS AND TIMETABLE:

OPERATIONAL PLANS FOR 1988

I. BIOASSAY DEVELOPMENT

A. Epidermal Growth Factor Binding Assay

First Quarter 1988

1. Determine the effect of cell density on EGF binding. (February 1)

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2. Begin to evaluate the effects of CSC fractions on EGF binding. (March 1)

Second Quarter 1988
1. Examine the time course of the CSC effect. (May 1)
2. Complete the evaluation of CSC fractions. (June 1)

Third Quarter 1988
1. Test CSCs from other model cigarettes. (July 1)
2. Using the EGF assay, investigate the activity of other classes of promoters. (September 1)

Fourth Quarter 1988
1. Begin to examine the pathway through which CSC inhibits EGF binding to aid in the development of a biochemical assay. (September 1)

Decision Point on EGF Assay: December 1988

B. Inhibition of Phorbol 12,13 -Dibutyrate (PDBu) Binding

First Quarter 1988
1. Obtain a response with 2R1 CSC. (March 1)

Second Quarter 1988
1. Optimize the response and determine the quantitative properties of the assay. (May 1)
2. Examine the effects of two model CSCs and catechol. (June 1)

Third Quarter 1988
1. Examine the effect of CSC on the affinity and number of PKC receptors. (July 1)

Decision Point on PDBu Assay: September 1988

C. Protein Kinase C (PKC) Activity Assay

First Quarter 1988
1. Examine the effect of CSC on the basal levels of the enzyme (time course and dose response experiments). (March 31)

Second Quarter 1988
1. Examine the effect of CSC on stimulated levels of the enzyme. (June 30)

Decision point on the PKC Activity Assay: July 1988

D. Protein Kinase C Activity in Intact Cells

1. Optimize assay conditions to obtain a positive response with TPA. (March 30)

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Second Quarter 1988

1. Develop methods for quantitation (obtain appropriate software). (Begin April 1)
2. Determine the effects of pre or post labeling with a promoter. (May 30)
3. Examine the labeling patterns of 3T3 cells with the PhastSystem using a variety of cell conditions (logarithmic, confluent, and serum-deprived) (July 1)

Third Quarter 1988

1. Complete a preliminary investigation of the effects of CSC. (October 1)

Fourth Quarter 1988

1. Perform additional experiments as needed on CSCs or fractions. (December 31)

Decision Point on the PKC Activity Assay in Intact Cells: December 1988

II. MODEL EVALUATION

A. Salmonella/microsome (S/M) Assay

First Quarter 1988

1. Evaluate the effects of filters (charcoal, THAM, basic alumina) on the S/M activity of washed shredded bright stem and BCR blend cigarettes. (March 1)

B. Glutathione Depletion Assay (GDA)

First Quarter 1988

1. Begin a literature search on the isolation and identification of GSH adducts. (February 1)
2. Evaluate the gas phase and whole smoke of BCR blend cigarettes with whistle through, THAM on charcoal, and basic alumina filters. (March 31)

Second Quarter 1988

1. Determine of effects of GSH depletion by CSC on activity measured in the S/M assay. (June 30)

Third Quarter 1988

1. Evaluate the activity of HCN in the GDA. (August 1)
2. Begin isolation and identification of GSH-CSC adducts. (August 1)

III. MODEL DEVELOPMENT

A. Crossed Solubles/ Base Web Study

First Quarter 1988

1. Compile and issue a report containing analytical data. (March 31)

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2. Begin an examination of the effect of ultrafiltration and size exclusion techniques. (January 1)
3. Begin an examination of selective ion exchange resins. (January 1)
4. Begin investigation of the effects of monovalent and divalent cations. (February 1)

Second Quarter 1988
1. Complete survey study of ultrafiltration and size exclusion techniques. (May 1)
2. Complete survey study of ion exchange resins. (June 1)

Third Quarter 1988
1. Begin investigation of effects of nitrogenous compounds on activity (amino acids, proteins, nitrate). (July 1)
2. Complete investigation of the effect of monovalent and divalent cations. (September 1)

Fourth Quarter 1988
1. Investigate the effect of sugar-chlorogenic acid or sugar-caffeic acid complexes on activity. (December 1)
2. Begin to investigate the effects of combining various modifications. (December 1)
3. Determine the effect of CEL insolubles on activity. (December 31)

IV. MODEL OPTIMIZATION

A. Carbonyl Reduction

First Quarter 1988
1. Evaluate the selective reduction of both formaldehyde and acrolein. (February 15)

B. NO_x Reduction

First Quarter 1988
1. Complete a literature search. (February 15)

2. Obtain and evaluate necessary papers. (March 15)
3. Investigate and establish analytical procedures suitable for NO_x determination in MS smoke. (March 15)

Second Quarter 1988
3. Design prototype filters for the reaction/adsorption of NO_x. (April 15)

EXTENDED PLANS:

BIOASSAY DEVELOPMENT:

1989: Begin to investigate other biochemical endpoints and techniques (mouse epidermal cell cultures, free radical mechanisms, intracellular calcium). Investigate other endpoints as evidence warrants. Begin to develop flow cytometry techniques.

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1990: Utilize Flow Cytometry to increase our sensitivity, efficiency, and capabilities with regard to in vitro bioassays.
1991: Develop an assay for promotion activity. Investigate the activity of CSC in assays measuring activity in other stages of Biological Activity.

MODEL EVALUATION:

1989-1992: Continue to evaluate models as needed.

MODEL DEVELOPMENT:

1989-1990: Combine all effective modifications to obtain a low activity model for the S/M assay. Begin extensive testing. Begin flavor work.
1991: Begin the development of low promotion activity models.

MODEL OPTIMIZATION:

1989-1990: Optimize the subjectives of a low S/M activity model.
1991: Begin work on optimizing the subjectives of a low promotion activity model.

RESOURCE ALLOCATIONS FOR 1988:

Personnel Allocations:

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GDA- B. McCoy(100%), B. Vaughan(40%)
Smoke and Sample Preparation: R. Hellams(40%), N. McGee(45%), R. Kinser (5%)

MODEL DEVELOPMENT:
Crossed Solubles/Base Web Study: D. Williams (25%), S. Coleman (25%)
Smoke and Sample Preparation: R. Hellams(40%), N. McGee(45%), R. Kinser (5%)

MODEL OPTIMIZATION:
Carbonyls and NO_x: B. Levins(65%), R. Kinser (10%)

2021555791

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Number of People:

There are immediate needs in the following areas:

1. A replacement for D. Stagg (T4) who is on special assignment. It is imperative that this person would require little training and have experience with sterile technique, mammalian cell culture, and handling radioactive materials. Due to the nature of our work, the use of a temporary employee in this area is not feasible. Because of the anticipated time frame involved, utilizing a technician who will require a significant amount of training would not provide us with an adequate return on our training investment. The feasibility of obtaining a qualified person from another area and replacing that person with a temp has been explored. Neither Bob McCuen nor Dick Cox had a T4-level individual with the appropriate qualifications. Based on this information and the uncertainty surrounding the duration of Ms. Stagg's assignment, I recommend that a full-time technician be hired to assist us in this area. Failure to do so will have a negative impact on the schedules outlined in this document.

2. A Chemist (replacement for David Williams who was on loan to us from Chemical Research) with some biology experience (Scientist or above) who can perform the following: crossed soluble/base web modifications and separations; coordinate model optimization (flavors), assist with the isolation and identification of GSH adducts, provide general assistance and chemical expertise to the Lowered Biological Activity Program.

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Skills of People:

See above.

Special Equipment and Facilities:

A Flow Cytometer (about $500K) could be utilized in 1989. This piece of equipment would have a significant impact on the sensitivity, efficiency, and capabilities of much of the biology/biochemistry related work. A thorough justification will be developed in 1988.

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Outside Expertise:

Occasional antibody work may need to be performed.

Impact on Other Areas of PM:

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Cigarette Testing: 30 man hours/year
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Semiworks: approximately 1/2 day/year

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Chemical Research: flavor development, beginning in 1989
NMR/MS (probably LC or FAB): for the isolation and identification of glutathione-CSC adducts, beginning in 1989
Flavor Development: assistance beginning in 1990

Mike Lynn

Cary Effi

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Operational Plan for the Optical Processing Program

November, 1988

A. Objective

In collaboration with Engineering and IS, develop and apply optical processing techniques to product inspection. Include both pack inspection and the high speed inspection of individual cigarettes.

B. Background

In December, 1986, an in-house optical processing course was presented by Dr. David Casasent, a professor at Carnegie Mellon University and a widely recognized leader in the field. The course and a subsequent trip to Dr. Casasent's laboratory convinced a number of people in R & D and Engineering that optical processing techniques could be powerful tools for the inspection of PM products. In February of 1987, B. C. LaRoy of R & D and E. E. Richardson of Engineering proposed plans for a joint R & D/Engineering project in optical processing and requested a research proposal from Dr. Casasent.

In February 1987, Professor Casasent submitted a three year proposal for research to be carried out at CMU in support of the optical processing program. The proposal, including funding for one full-time graduate student, was promptly approved and is being reviewed quarterly.

In July of 1987, an optics laboratory staffed by an associate senior scientist was established within the physical research division. A research scientist was added to the effort in October, a senior scientist added in January of 1988 and a technician added in June of 1988.

In November of 1988, a unique digital inspection system, developed within the optical processing program, was demonstrated to R & D management from several of the Philip Morris operating companies. The system demonstrated had an automatic training feature and the capability for high resolution inspection at the rate of 10 objects per second.

C. Status

Since its establishment, the effort of the optical processing program has been divided among five major activities. These actiivities include (1) image library acquisition and experiments carried out to demonstrate, develop and evaluate optical processing techniques, (2) theoretical studies directed toward the development of improved techniques for discriminating between acceptable and

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unacceptable images, (3) evaluation of the Global Holonetics "Smart Camera", (4) the development of methods for the inspection of individual cigarettes and (5) contract research carried out at CMU. A brief summary of each of these activities is given below.

1. Optical Processing Laboratory

The activities carried out in the optical processing laboratory have included the demonstration of a number of optical processing techniques. Some of the more sophisiticated systems have incorporated specially modified liquid crystal televisions, computer generated holograms, Fourier transform optics, optically generated holograms, and optical correlators. Project personnel have evaluated and will continue to evaluate commercial spatial light modulators as they become available. The modulators that have been evaluated to date have been found to lack the performance needed for successful implementation of the optical processing techniques considered. It is hoped that this situation will improve in the near future as more suppliers enter the market.

Project personnel have investigated the effect that lighting plays in the ability to discriminate among various types of defective cigarette packs. The knowledge gained from these investigations has been used in the establishment of several digital image libraries needed for the theoretical studies.

2. Theoretical Studies

In all inspection schemes, an algorithm is needed to discriminate between acceptable and unacceptable images. To date, we have restricted our attention to algorithms which are linear in the image intensities and take into account the full resolution of the image. The simplest of such inspection schemes consists of multiplying a test image by another image, referred to as the filter image and comparing the result with a threshold value. Our theoretical efforts have been devoted to developing methods for constructing a filter image from a set of training images in such a way as to provide us with optimum inspection capability. Our current technique has been shown to have excellent capability for detecting gross defects following an automatic training procedure. Current efforts are directed toward modifying the technique to improve the capability for detecting small blemishes which may alter as little as 5/10,000 of the image.

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3. Global Holonetics Smart Camera

Global Holonetics of Fairfield, Iowa has developed a system (the GHC "SMART CAMERA") that uses optical processing techniques for on-line inspection problems. An early model of this system was received and evaluated. The system has the ability to be "trained" to discriminate between good and defective packs and also to classify various types of defects. Initially this ability to discriminate could be maintained for no more than two to three hours due to the drift in the instrument output. Project personnel have worked closely with the manufacturer and identified the source of the drift as a sensitivity to changes in temperature. The manufacturer is pursuing two general approaches for eliminating the excess thermal sensitivity. The first approach incorporates temperature control within the instrument and a neural network to compensate for any residual temperature variation. The second approach to the reduction of the thermal sensitivity has required extensive redesign of the support system for the optics. Project personnel feel that the new system will be useful for our pack inspection problems. The availability date for a thermally stable system remains in question.

4. Individual Cigarette Inspection

The inspection of individual cigarettes presents new problems not encountered in the pack inspection problem. Of these, the two most challenging are the increased speed requirements (a factor of 20) and the difficulty of acquiring a complete view of the cigarette during the making process.

Several approaches to single cigarette monitoring have been formulated. They vary in sophistication from modification of the signal analyzer on the Accuray CIM (cigarette inspection module) system to a completely new acousto-optics based system to be placed after the tipper for total finished cigarette inspection. A laboratory system has been set up to aid in the modification of the CIM system. To facilitate the development of the more sophisticated system, project personnel have interacted with experts in acousto-optic instrumentation. A consulting relationship has been established with Dr. A. Vanderlugt, one of the nation's leading experts in acousto-optic instrumentation, and Brimrose Corporation has been requested to develop preliminary designs for an acousto-optic based scanner system.

5. Research at Professor Casasent's Laboratory at Carnegie Mellon University

Philip Morris funded research at CMU was initiated in February of 1987. The first year effort at CMU was concentrated on the evaluation of a system based on the Hough transform. A patent on a method for

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product inspection based on the Hough transformation was applied for jointly with Philip Morris.

During the second year of the Philip morris funded research at CMU, further progress was made in the development of a product inspection system based on the Hough transform. A high resolution computer generated hologram (CGH) for generating different slices of the Hough transform was designed and fabricated. A system incorporating this CGH was built to evaluate the capability of the Hough transform system for pack inspection. Work has also begun on other inspection architectures including an acousto-optic based Hough transform system for pack inspection, a morphological based inspection system with unique capabilities and a warning label inspection system.

D. Strategies

1. Evaluate the PM developed product inspection system in a simulated manufacturing environment.

2. Secure a proprietary position for the PM developed digital product inspection system.

3. Collaborate with a vendor and/or independent laboratory on the development of a higher performance digital product inspection system.

4. Modify the digital inspection algorithm to enhance its capability for the detection of blemishes.

5. Develop and implement an automated system for the off-line inspection of cut closure stamps.

6. Evaluate the Global Holonetics "Smart Camera" in a manufacturing environment.

7. Continue the collaborative relationship with CMU.

8. Implement an individual cigarette inspection system in the laboratory.

9. Enhance the inspection capability of the CIM inspection system.

E. Tactics

1. Strategy 1

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a. Assemble a new set of cigarette packs including 200-400 of each of the major defects. Use a hand-held pack gauge to insure the correct class assignment for each pack. - 4th quarter 1988.

b. Install the digital inspection system in the Operations Center, configuring it to inspect a single view of the pack as it is transported through the field of view of the camera.

c. Optimize the system and quantify the inspection capability. - 1st quarter 1989.

2. **Strategy 2**

a. Edit the current draft of the patent application and return to the Patent Department. - Dec 1, 1988.

b. Submit continuations to the patent as significant improvements are made.

3. **Strategy 3**

a. Identify three vendors or independent laboratories to be considered for collaboration on the development of the high performance system. - Dec. 15, 1988.

B. Establish a collaborative program with the most promising vendor/laboratory. - Jan. 15, 1989.

4. **Strategy 4**

a. Enhance the current video library to include classes of blemishes of varying magnitude. Create the blemished images by digitally modifying the acceptable product images. - Dec. 15, 1988.

b. Examine the relative merits of the several techniques currently under consideration for enhanced detection of blemishes. - Feb. 1, 1989.

5. **Strategy 5**

a. Design, fabricate and implement a mechanism for presenting cut closure stamps to a camera.

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b. Design an interface to trigger a strobe light and video frame grabber as each stamp is presented.

c. Develop an algorithm for reliable closure stamp inspection which can be implemented at reasonable speeds (<1/sec) with readily available hardware.

d. In collaboration with QC personnel, evaluate the defect detection capabilities of the cut closure inspection system. - 1st quarter, 1989.

d. Transfer the inspection system to QC. - 2nd quarter 1989.

6. **Strategy 6**

a. In collaboration with Engineering, evaluate the defect detection capabilities of the Global Holonetics "Smart Camera" in a simulated manufacturing setting. - 1st Quarter, 1989 (subject to availability)

7. **Strategy 7**

a. Continue reviewing the CMU program on a quarterly basis.

8. **Strategy 8**

a. Conclude feasibility analysis of polygon mirror and CCD array scanning system. - 1st quarter 1989.

b. Develop a high speed scanning and cigarette transport system for the surface inspection of individual cigarettes. - 2nd quarter 1989.

c. Develop inspection algorithms which enable reliable accept/reject decisions to be formed from data provided by high speed scanning. Restrict consideration to those algorithms with the potential for implementation at production rates.

d. Implement the individual cigarette monitoring system in the laboratory. - 1st quarter 1990.

9. **Strategy 9**

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a. Develop improved algorithms for the processing of data from the Hauni cigarette inspection module (CIM) - 1st quarter 1989.

b. Develop the hardware needed to implement the algorithms. - 2nd quarter 1989.

RESOURCE ALLOCATIONS

Current

1. Bob Maher, research scientist
2. Charles Harward, asociate senior scientist
3. Dave Lowitz, senior scientist
4. Ken Cox, research scientist (1/2 time)
5. Michael Mullins, technician (T4)

Additional Resource Needs

Personnel

scientist

responsibilities: collaborate in the development of a device for the inspection of individual cigarettes. The person should be an experimentalist with a knowledge of pattern recognition techniques. An electrical engineering background is essential.

(personnel search in progress)

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August 1, 1988

CONFIDENTIAL

Operational Plan for the Optical Processing Program

A. Objective

In collaboration with Engineering and IS, develop and apply optical processing techniques to product inspection. Include both pack inspection and the high speed inspection of individual cigarettes.

B. Background

In December, 1987, an in-house optical processing course was presented by Dr. David Casasent, a professor at Carnegie Mellon University and a widely recognized leader in the field. The course and a subsequent trip to Dr. Casasent's laboratory convinced a number of people in R & D and Engineering that optical processing techniques could be powerful tools for the inspection of PM products. In February of 1987 B. C. LaRoy of R & D and E. E. Richardson of Engineering proposed plans for a joint R & D/Engineering project in optical processing and requested a research proposal from Dr. Casasent.

In February 1987, Professor Casasent submitted a three year proposal for research to be carried out at CMU in support of the optical processing program. The proposal, including funding for one full-time graduate student, was promptly approved and is being reviewed quarterly.

In July of 1987, an optics laboratory staffed by an associate senior scientist was established within the physical research division. A research scientist was added to the effort on a temporary basis in October, a senior scientist added in January and a technician added in June of 1988.

C. Status

Since its establishment, the effort of the optical processing program has been divided among four major activities. These activities include image library acquisition and experiments demonstrating optical processing techniques carried out in the optics laboratory, evaluation of the Global Holonetics "Smart Camera", theoretical studies directed toward the development of both optical and digital filters, the development of methods for the inspection of individual cigarettes and contract research carried out at CMU. A brief summary of each of these activities is given below.

1. Optical Processing Laboratory

The key activities carried out in the optical processing laboratory are listed below:

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a. Fourier transform optics were set up using both film and liquid crystal TV (LCTV) images.
b. Optical spatial filtering was demonstrated.
c. Techniques for making computer generated holograms from film were developed.
d. A small portable optical processing system was designed and fabricated.
e. Different lighting techniques were investigated.
f. A library of video images of representative cigarette packs was established. Images of both acceptable and unacceptable packs were included.
g. Techniques for fabricating optical holograms were developed.
h. LCTV's were modified for use as spatial light modulators.
i. Optical correlation filters were fabricated using both film and LCD TV input images.
j. Techniques were developed for electronic edge enhancement using the modified LCTV.

2. Global Holonetics Smart Camera

Global Holonetics of Fairfield, Iowa (a company with which Professor Casasent is associated) has developed a system (the GHC "SMART CAMERA") that uses optical processing techniques for on-line inspection problems. An early model of this system was received and evaluated. The system has the ability to be "trained" to discriminate between good and defective packs and also to classify various types of defects. Initially this ability to discriminate could be maintained for no more than two to three hours due to the drift in the instrument output. Project personnel have been and are continuing to work closely with the manufacturer to identify the source of this drift and correct it. Several new versions of the instrument have been obtained from the manufacturer since the first system arrived in November, 1987. These incorporated changes that made the instrument more sensitive to defects. Unfortunately, none of these versions have had sufficient stability to allow us to proceed with evaluation of the system on a simulated assembly line as planned. We have given Global Holonetics a stability target which they are attempting to achieve. They have not been able to provide us with a reliable estimate of the time required for them to reach the target.

3. Filter Development (theoretical)

In many inspection schemes, a filter is required in order to discriminate between acceptable and unacceptable images. The filter design is based on a training set of acceptable and unacceptable images. Methods for designing such filters are an area of active research. Two types of filters have been under consideration, each corresponding to a different detection scheme.

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a. Matched Spatial Filters

One very promising optical inspection system uses a synthetic discriminant function as a matched spatial filter in a correlator. Such a system is expected to be useful for the detection of smaller defects which cannot be reliably detected by systems such as that employed by the Global Holonetics unit. The filter is a computer generated hologram (CGH) which must be designed so that the system output contains a peak for acceptable images but no peak for unacceptable images. Numerical algorithms for designing several different types of filters have been developed. The new algorithms are expected to overcome some of the deficiencies of earlier approaches, allowing for larger training sets, high resolution images and small differences between acceptable and unacceptable images. The software needed to implement the algorithms has been written and the algorithms tested using two different video image libraries. The most recent test was carried out on an image library containing 1500 images of both good packs and packs representing three different types of defects. The results look very encouraging.

b. Digital Filter Development

The simplest full resolution digital operation that can be carried out on an image to classify it (as acceptable or unacceptable, for example) is a point by point multiplication of the image with a 'filter' image followed by a summation. The digital filter would be designed so that the number resulting from the multiplication and summation would equal 1. for an acceptable image and 0. for an unacceptable image. It appears to be possible to carry out such a computation at video framerates. A system based on such a computation would offer several advantages. It would not require any optical components and the digital filter could be easily changed. The filters needed for such a digital system are simply related to those described above, which are being developed for optical implementation. A list of hardware needed for such a digital system has been assembled by Cary Longest from Engineering. The hardware will be purchased and further testing of the concept carried out after successful numerical testing of the concept.

4. Individual Cigarette Inspection

The inspection of individual cigarettes presents new problems not encountered in the pack inspection problem. Of these, the two most challenging are the increased speed requirements (a factor of 20) and the difficulty of acquiring a complete view of the cigarette during the making process.

Several approaches to single cigarette monitoring have been formulated. They vary in sophistication from modification of the signal analyzer on the Accuray CIM (cigarette inspection module)

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system to a completely new acousto-optics based system to be placed after the tipper for total finished cigarette inspection. A laboratory system has been set up to aid in the modification of the CIM system. To facilitate the development of the more sophisticated system, a consulting relationship has been established with Dr. A. Vanderlugt, of one of the nation's leading experts in acousto-optic instrumentation.

5. Research at Professor Casasent's Laboratory at Carnegie Mellon University

Philip Morris funded research at CMU was initiated in February of 1987. Plans for the first year included fabrication and initial testing of laboratory versions of general purpose optical inspection processors. Intended for consideration were an optical Hough transform processor and an optical Fourier transform wedge ring detector processor both operating from 2-D liquid crystal television input data. Since a commercial instrument based on the latter processor became available (the "Smart Camera" from Global Holonetics), the first year effort at CMU was concentrated on the evaluation of a system based on the Hough transform. A patent on a method for product inspection based on the Hough transformation was applied for jointly with Philip Morris.

An optical system for generating a number of theta slices of the Hough transform has been designed, fabricated and tested on representative test images. Key components in this system include a lensless computer generated hologram and an optical edge enhancement technique developed by Charles Harward. Once the resolution of the hologram has been improved, extensive testing of the discriminating capability of the system will be carried out using acceptable and defective cigarette packs.

As the Philip Morris funded research at CMU moves into the second quarter of the second year, additional research problems are being undertaken and planned. Significant progress has already been made in the development of a correlator for warning label inspection. The detection method has been successfully simulated numerically and will now be tested in the laboratory. As work on the Hough transform pack inspection system and warning label inspection system are completed, the attention will shift to high speed label inspection at the printer.

D. Strategies

1. Evaluate and assist in the development of the Global Holonetics "Smart Camera" .

2. Evaluate the performance of the "Smart Camera" for additional inspection problems.

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3. Develop and implement methods for the calculation of synthetic discriminant functions. These functions are needed to create either optical or digital filters for use in a correlator for the detection of unacceptable images. The functions are needed for items 6 and 7 below.

4. Develop and evaluate new methods for the high speed inspection of individual cigarettes.

5. Test the performance of a Hough transform system for pack inspection.

6. Carry out a laboratory evaluation of a system employing a synthetic discriminant function as a matched spatial filter in a correlator.

7. Examine numerically the performance of a digital filter for pack inspection. Construct a device once feasibility has been demonstrated.

8. Continue the collaborative relationship with CMU.

9. Implement the warning label inspection system once feasibility has been established by experiments caried out at CMU.

E. Tactics

1. Strategy 1

a. In collaboration with Engineering, evaluate the defect detection capabilities of the Global Holonetics "Smart Camera" in a simulated manufacturing setting. - 3rd Quarter, 1988.

c. Assist Engineering as needed in the transfer of the system to manufacturing.

2. Strategy 2

a. Acquire representative acceptable and unacceptable video images pertinent to the inspection problems under consideration.

b. Develop techniques for the transfer of video images to the "Smart Camera".

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c. Assess the capability (speed, reliability) of the "Smart Camera" for differentiating acceptable from unacceptable in each of the problems considered

- 3rd quarter 1988

3. **Strategy 3**

a. Construct and test a filter trained on both good packs and packs with a missing closure. - September 1, 1988.

b. Design a spatial filter for laboratory testing. - October 1, 1988.

4. **Strategy 4**

a. Develop a detection method. - 3rd quarter 1988

b. Implement and test the detection method in the laboratory. - 1st quarter 1989

c. Assist engineering in the evaluation of the method in a manufacturing setting. - 2nd quarter 1989

d. Transfer the method to manufacturing. - 3rd quarter 1989

5. **Strategy 5**

a. Following a demonstation by CMU of its utility in an inspection problem, construct an optical Hough transformation system using CMU design spectifications. - Timetable dependent upon progress at CMU

6. **Strategy 6**

a. Obtain a high resolution spatial light modulator. - August 15, 1988. (The delivery date has been repeatedly postponed by the manufacturer.)

b. Determine the transformation needed to make the output from the camera/frame grabber linear in light amplitude. - August 15, 1988.

c. Verify that Fourier transform of an image of a cigarette pack displayed on the spatial light modulator is sufficiently consistent with theoretical expectations. - September 1,1988.

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d. Complete the acquisition of the video library needed for the calculation of the synthetic discriminant function (SDF). - September 15, 1988

e. Design an optical system employing a numerically generated synthetic discriminant function (SDF) as a matched spatial filter in a correlator. - September 1, 1988

f. Calculate the SDF corresponding to the new image library and test numerically. - October 1,1988

g. Have a matched spatial filter fabricated. - November 1, 1988

h. Carry out laboratory testing of the discriminating ability of the system. - December 1, 1988

7. **Strategy 7**

a. Carry out a test of the digital domain filter on the updated video image library. - September 1, 1988.

c. Construct a device capable of carrying out the digital inspection. - 3rd quarter, 1988. (Contingent upon outcome of b.)

8. **Strategy 8**

a. Continue reviewing the CMU program on a quarterly basis.

9. **Strategy 9**

a. Modify the system developed by CMU in order to permit real time inspection in the laboratory. - 2nd quarter 1989

b. Evaluate the system in the laboratory. - 3rd quarter 1989

c. Develop an inspection system suitable for further testing in a manufacturing environment. - 4th quarter 1989

RESOURCE ALLOCATIONS

Current

1. Bob Maher, research scientist
2. Charles Harward, asociate senior scientist

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3. Dave Lowitz, senior scientist
4. Ken Cox, research scientist (1/4 time)
5. Michael Mullins, technician (T4)

Additional Resource Needs

Personnel

scientist

responsibilities: collaborate with Dave Lowitz in the development of a device for the inspection of individual cigarettes. The person should be an experimentalist with an appreciation for theory. An electrical engineering background would be highly beneficial.

(personnel search in progress)

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Revised 6/6/88

CONFIDENTIAL

Operational Plan for the Optical Processing Program

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B. Background

In December, 1987, an in-house optical processing course was presented by Dr. David Casasent, a professor at Carnegie Mellon University and a widely recognized leader in the field. The course and a subsequent trip to Dr. Casasent's laboratory convinced a number of people in R & D and Engineering that optical processing techniques could be powerful tools for the inspection of PM products. In February of 1987 B. C. LaRoy of R & D and E. E. Richardson of Engineering proposed plans for a joint R & D/Engineering project in optical processing and requested a research proposal from Dr. Casasent.

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Since its establishment, the effort of the optical processing program has been divided among four major activities. These activities include image library acquisition and experiments demonstrating optical processing techniques carried out in the optics laboratory, evaluation of the Global Holonetics "Smart Camera", theoretical studies directed toward the development of both optical and digital filters, the development of methods for the inspection of individual cigarettes and contract research carried out at CMU. A brief summary of each of these activities is given below.

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3. Filter Development (theoretical)

In many inspection schemes, a filter is required in order to discriminate between acceptable and unacceptable images. The filter design is based on a training set of acceptable and unacceptable images. Methods for designing such filters are an area of active research. Two types of filters have been under consideration, each corresponding to a different detection scheme.

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a. Matched Spatial Filters

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b. Digtal Filter Development

The simplest full resolution digital operation that can be carried out on an image to classify it (as acceptable or unacceptable, for example) is a point by point multiplication of the image with a 'filter' image followed by a summation. The digital filter would be designed so that the number resulting from the multiplication and summation would equal 1. for an acceptable image and 0. for an unacceptable image. It appears to be possible to carry out such a computation at video framerates. A system based on such a computation would offer several advantages. It would not require any optical components and the digital filter could be easily changed. The filters needed for such a digital system are simply related to those described above, which are being developed for optical implementation. A list of hardware needed for such a digital system has been assembled by Cary Longest from Engineering. The hardware will be purchased and further testing of the concept carried out after successful numerical testing of the concept.

4. Individual Cigarette Inspection

The inspection of individual cigarettes presents new problems not encountered in the pack inspection problem. Of these, the two most challenging are the increased speed requirements (a factor of 20) and the difficulty of acquiring a complete view of the cigarette during the making process.

Several approaches to single cigarette monitoring have been formulated. They vary in sophistication from modification of the signal analyzer on the Accuray CIM (cigatette inspection module)

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system to a completely new acousto-optics based system to be placed after the tipper for total finished cigarette inspection. A laboratory system has been set up to aid in the modification of the CIM system. To facilitate the development of the more sophisticated system, arrangements have been made to obtain the consulting services of one of the nation's leading experts in acousto-optic instrumentation.

5. Research at Professor Casasent's Laboratory at Carnegie Mellon University

Philip Morris funded research at CMU was initiated in February of 1987. Plans for the first year included fabrication and initial testing of laboratory versions of general purpose optical inspection processors. Intended for consideration were an optical Hough transform processor and an optical Fourier transform wedge ring detector processor both operating from 2-D liquid crystal television input data. Since a commercial instrument based on the latter processor became available (the "Smart Camera" from Global Holonetics), the first year effort at CMU was concentrated on the evaluation of a system based on the Hough transform. A patent on a method for product inspection based on the Hough transformation was applied for jointly with Philip Morris.

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As the Philip Morris funded research at CMU moves into the second quarter of the second year, additional research problems are being undertaken and planned. Significant progress has already been made in the development of a correlator for warning label inspecion. The detection method has been successfully simulated numerically and will now be tested in the laboratory. As work on the Hough transform pack inspection system and warning label inspection system are completed, the attention will shift to high speed label inspection at the printer.

D. Strategies

1. Evaluate and assist in the develoment of the Global Holonetics "Smart Camera" .

2. Evaluate the performance of the "Smart Camera" for additional inspection problems.

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3. Develop and implement methods for the calculation of synthetic discriminant functions. These functions are needed to create either optical or digital filters for use in a correlator for the detection of unacceptable images. The functions are needed for items 6 and 7 below.

4. Develop and evaluate new methods for the high speed inspection of individual cigarettes.

5. Test the performance of a Hough transform system for pack inspection.

6. Carry out a laboratory evaluation of a system employing a synthetic discriminant function as a matched spatial filter in a correlator.

7. Examine numerically the performance of a digital filter for pack inspection. Construct a device once feasibility has been demonstrated.

8. Continue the collaborative relationship with CMU.

9. Implement the warning label inspection system once feasibility has been established by experiments caried out at CMU.

E. Tactics

1. Strategy 1

a. In collaboration with Engineering, evaluate the defect detection capabilities of the Global Holonetics "Smart Camera" in a simulated manufacturing setting. - July 15, 1988.

c. Assist Engineering as needed in the transfer of the system to manufacturing.

2. Strategy 2

a. Acquire representative acceptable and unacceptable video images pertinent to the inspection problems under consideration.

b. Develop techniques for the transfer of video images to the "Smart Camera".

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c. Assess the capability (speed, reliability) of the "Smart Camera" for differentiating acceptable from unacceptable in each of the problems considered

- 3rd quarter 1988

3. Strategy 3

a. Complete comparative evaluations of several filter design algorithms using the current video library. - July 1, 1988

b. Modify and retest the best algorithm using a more extensive image library. - September 1, 1988.

c. Design a spatial filter for laboratory testing. - October 1, 1988.

4. Strategy 4

a. Develop a detection method. - 3rd quarter 1988

b. Implement and test the detection method in the laboratory. - 1st quarter 1989

c. Assist engineering in the evaluation of the method in a manufacturing setting. - 2nd quarter 1989

d. Transfer the method to manufacturing. - 3rd quarter 1989

5. Strategy 5

a. Following a demonstation by CMU of its utility in an inspection problem, construct an optical Hough transformation system using CMU design spectifications. - Timetable dependent upon progress at CMU

6. Strategy 6

a. Obtain a high resolution spatial light modulator. - July 1.

b. Correlate the video image of a pack with an optically generated filter using the high resolution spatial light modulator. - August 1, 1988.

c. Complete the acquisition of the video library needed for the calculation of the synthetic discriminant function (SDF). - August 1, 1988

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d. Design an optical system employing a numerically generated synthetic discriminant function (SDF) as a matched spatial filter in a correlator. - September 1, 1988

e. Calculate the SDF corresponding to the new image library and test numerically. - September 1,1988

f. Have a matched spatial filter fabricated. - Novermber 1, 1988

g. Carry out laboratory testing of the discriminating ability of the system. - December 1, 1988

7. **Strategy 7**

a. Complete the development and testing of a digital domain filter. - July 1, 1988.

b. Test the concept on the updated video image library. - September 1, 1988.

c. Construct a device capable of carrying out the digital inspection. - 3rd quarter, 1988. (Contingent upon outcome of b.)

8. **Strategy 8**

a. Continue reviewing the CMU program on a quarterly basis.

9. **Strategy 9**

a. Modify the system developed by CMU in order to permit real time inspection in the laboratory. - 2nd quarter 1989

b. Evaluate the system in the laboratory. - 3rd quarter 1989

c. Develop an inspection system suitable for further testing in a manufacturing environment. - 4th quarter 1989

RESOURCE ALLOCATIONS

Current

1. Bob Maher, research scientist
2. Charles Harward, asociate senior scientist

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

3. Dave Lowitz, senior scientist
4. Ken Cox, research scientist (1/4 time)
5. Michael Mullins, technician (T4)

Additional Resource Needs

Personnel

scientist

responsibilities: collaborate with Dave Lowitz in the development of a device for the inspection of individual cigarettes. The person should be an experimentalist with an appreciation for theory. An electrical engineering background would be highly beneficial.

(personnel search in progress)

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...TIAL

Operational Plan for the Optical Processing Program

A. Objective

In collaboration with Engineering and IS, develop and apply optical processing techniques to product inspection. Include both pack inspection and the high speed inspection of individual cigarettes.

B. Background

In December, 1986, an in-house optical processing course was presented by Dr. David Casasent, a professor at Carnegie Mellon University and a widely recognized leader in the field. The course and a subsequent trip to Dr. Casasent's laboratory convinced a number of people in R & D and Engineering that optical processing techniques could be powerful tools for the inspection of PM products. In February of 1987 B. C. LaRoy of R & D and E. E. Richardson of Engineering proposed plans for a joint R & D/Engineering project in optical processing and requested a research proposal from Dr. Casasent.

In February, Professor Casasent submitted a three year proposal for research to be carried out at CMU in support of the optical processing program. The proposal, including funding for one full-time graduate student, was promptly approved and is being reviewed quarterly.

In July of 1987, an optics laboratory staffed by an associate senior scientist was established within the physical research division. A research scientist was added to the effort on a temporary basis in October and a second senior scientist added in January of 1988.

C. Status

Since its establishment earlier this year, the effort of the optical processing program has been divided among four major activities. These activities include experimental investigations carried in the optics laboratory, evaluation of the Global Holonetics "Smart Camera", theoretical studies directed toward the development of both spatial and digital filters, and the work carried out by David Casasent's group at CMU. A brief summary of each of these activities is given below.

1. Optical Processing Laboratory

An Optical Processing Laboratory was set up during the past year. A variety of activities were carried out.

a. Fourier transform optics were set up using film and liquid crystal TV (LCTV) images.

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b. Optical spatial filtering was demonstrated.
c. Film techniques for making computer generated holograms were developed.
d. A small portable optical processing system was designed and fabricated.
e. Different lighting techniques were investigated.
f. A library of video images of representative cigarette packs was established.
g. Techniques for fabricating optical holograms were developed.
h. An optical correlation filter was fabricated.
i. LCTV's were modified for use as spatial light modulators.
j. Techniques for electronic edge enhancement using the modified LCTV were investigated.

2. Global Holonetics Smart Camera

Global Holonetics of Fairfield, Iowa (a company with which Professor Casasent is associated) has developed a system that uses optical processing techniques for on-line inspection problems. An early model of this system was received and evaluated. The system has the ability to be "trained" to discriminate between good and defective packs and also to classify various types of defects. However, this ability to discriminate could be maintained for no more than two to three hours due to the drift in the instrument output. Project personnel are working closely with the manufacturer to identify the source of this drift in order to correct this problem. A new version of the instrument, due to arrive from the Manufacturer by February 11, 1988, will incorporate changes that will make the system more stable. This new system is expected to be a powerful tool for the detection of pack defects.

3. Filter Development (theoretical)

In many inspection schemes, a filter is required in order to discriminate between acceptable and unacceptable images. The filter design is based on a training set of acceptable and unacceptable images. Methods for designing such filters are an area of active research. Two types of filters have been under consideration, each corresponding to a different detection scheme.

a. Matched Spatial Filters

One very promising optical inspection system uses a synthetic discriminant function as a matched spatial filter in a correlator. Such a system is expected to be useful for the detection of smaller defects which cannot be reliably detected by systems such as that employed by the Global Holonetics unit. The filter is a computer generated hologram (CGH) which must be designed so that the system output contains a peak of unit height for acceptable images but no peak for unacceptable images. A numerical algorithm for designing

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such a CGH has been developed. The new algorithm is expected to overcome some of the deficiencies off earlier approaches, allowing for larger training sets, high resolution images and small differences between acceptable and unacceptable images. The software needed to implement this algorithm has been written. Using a set images of good and defective packs, a filter was designed and tested numerically. The filter worked well in limited testing. Improvements in the algorithm will be made prior to more complete testing.

b. Dital Filter Development

The simplest full resolution digital operation that can be carried out on an image to classify it (as acceptable or unacceptable, for example) is a point by point multiplication of the image with a 'filter' image followed by a summation. The digital filter would be designed so that the number resulting from the multiplication and summation would equal 1. for an acceptable image and 0. for an unacceptable image. It appears to be possible to carry out such a computation at video framerates. A system based on such a computation would offer several advantages. It would not require any optical components and the digital filter could be easily changed. The theory for obtaining the digital filter needed for such a system has been developed (in project 1702) but has not yet been tested numerically.

4. Research at Professor Casasent's Laboratory at Carnegie Mellon University

Philip Morris funded research at CMU was initiated in February of 1987. Plans for the first year included fabrication and initial testing of laboratory versions of general purpose optical inspection processors. Intended for consideration were an optical Hough transform processor and an optical Fourier transform wedge ring detector processor both operating from 2-D liquid crystal television input data. Since a commercial instrument based on the latter processor became available (the "Smart Camera" from Global Holonetics), the effort at CMU has been concentrated on the evaluation of a system based on the Hough transform. A patent on a method for product inspection based on the Hough transformation was applied for jointly with Philip Morris. Additionally, preliminary digital simulations have been carried out to determine the feasibility of correlating with integrated warning label data to determine if the correct label is present or if it is smeared.

D. Strategies

1. Evaluate the performance of the next release of the Global Holonetics "Smart Camera" .

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2. Evaluate the performance of the "Smart Camera" for additional inspection problems. Consider:
   a. hopper jams
   b. black eyes
   c. printer errors

3. Develop and implement methods for the calculation of synthetic discriminant functions. These functions can be used to create matched spatial filters which are used in a correlator for the detection of unacceptable images.

4. Develop and evaluate new methods for the high speed inspection of individual cigarettes.

5. Test the performance of a Hough transform system for pack inspection.

6. Carry out a laboratory evaluation of a system employing a synthetic discriminant function as a matched spatial filter in a correlator.

7. Examine numerically the performance of a digital filter for pack inspection. Construct a device once feasibility has been demonstrated.

8. Continue the collaborative relationship with CMU.

E. Tactics

1. Strategy 1

a. Receive the new release of the Global Holonetics "Smart Camera". - Feb. 11.

b. Complete the laboratory evaluation of the instrument's long and short term stability. - Feb. 18.

c. Evaluate the system's defect detection capabilities using good and defective (fabricated) packs. - Feb. 25.

d. Complete the transfer of the "Smart Camera" system to Engineering for evaluation in a simulated manufacturing setting. - Mar. 10.

e. Assist Engineering as needed in the transfer of the system to manufacturing.

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2. **Strategy 2**

a. Acquire representative acceptable and unacceptable video images pertinent to the inspection problems under consideration.

b. Develop techniques for the transfer of video images to the "Smart Camera".

c. Assess the capability (speed, reliability) of the "Smart Camera" for differentiating acceptable from unacceptable in each of the problems considered

- 3rd quarter 1988

3. **Strategy 3**

a. Implement the minimum average correlation energy (MACE) algorithm for the calculation of spatial filters. - Feb. 8, 1988.

b. Test the resulting filter using the current video library. - Feb. 15, 1988.

c. Extend the filter design capability to include the classification of defects where more than one type of defect is present. - March 1,1988

d. Design a spatial filter based on the updated video image library. - June 1,1988.

4. **Strategy 4**

a. Complete a review of current cigarette defect problems and identification of defects suitable for visual monitoring. - March 1988.

b . Develop a detection method. - 2nd quarter 1988

c. Implement and test the detection method in the laboratory. - 4th quarter 1988

d. Assist engineering in the evaluation of the method in a manufacturing setting. - 1st quarter 1989

e. Transfer the method to manufacturing. - 2nd quarter 1989

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5. **Strategy 5**

a. Refine image edge enhancement techniques.

b. Following a demonstation by CMU of its utility in an inspection problem, construct an optical Hough transformation system using CMU design spectifications. Consider a system employing a cylindrical lenses with a rotating element as well as one incorporating a computer generated holographic optical element. - Timetable dependent upon progress at CMU

6. **Strategy 6**

a. Successfully carry out an autocorrelation experiment in the laboratory. Correlate a video image of a pack with an optically generated filter. - March 24, 1988.

b. Obtain a high resolution spatial light modulator. - April 1.

c. Repeat the autocorrelation experiment with the high resolution spatial light modulator. - April 15.

d. Use the information gained to design an optical system employing a numerically generated synthetic discriminant function (SDF) as a matched spatial filter in a correlator. - May 1,1988

e. Complete the acquisition of the video library needed for the calculation of the synthetic discriminant function (SDF). - May 1, 1988

f. Calculate the SDF corresponding to the new image library and test numerically. - June 1,1988

g. Have a matched spatial filter fabricated. - June 1, 1988

7. **Strategy 7**

a. Complete the development and testing of a digital domain filter. - April 15, 1988.

b. Test the concept on the updated video image library. - July 1, 1988.

c. Construct a device capable of carrying out the digital inspection. - 1st quarter, 1989. (Contingent upon outcome of b.)

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8. **Strategy 8**

a. Continue reviewing the CMU program on a quarterly basis.

RESOURCE ALLOCATIONS

Current

1. Bob Maher, research scientist (temporary: Oct, 1987 - April 1, 1988)
2. Charles Harward, asociate senior scientist
3. Dave Lowitz, senior scientist

d. Ken Cox, research scientist (1/4 time)

Additional Resource Needs

Personnel

1. technician

responsibilities: needed to assist Charles Harward in data collection and instrument evaluation. This will allow Charles more time for the development of new detection systems.

when needed: March 1,1988

2. indefinite extension of Bob Maher's transfer to physical research

responsibilities: filter design and fabrication, general software development and computer technical support within the project.

3. scientist

responsibilities: collaborate with Dave Lowitz in the development of a device for the inspection of individual cigarettes. The person should be an experimentalist with an appreciation for theory. An electrical engineering background would be highly beneficial.

Major Equipment

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Worm technology laser disk for video image storage and retrieval.
Estimated cost: $150,000

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Project Art

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

CONFIDENTIAL

Richmond, Virginia

To: Mr. A. C. Lilly **Date:** July 20, 1988

From: .H. Alonso

Subject: .ART PROGRAM OPERATIONAL PLAN

There are no changes to the ART program resulting from the second quarter planning meeting.

Attached is a copy of the transparencies used in the ART program discussion.

Hector Alonso

/jsa

cc: D. B. Knudson
H. L. Spielberg

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ART PROGRAM OBJECTIVES

1. Develop products with best subjectives from filler that has had 97 percent of its nicotine extracted with supercritical CO_2.

2. Develop and implement a commercial supercritical CO_2 process to remove 97 percent of the extractable nicotine from filler.

3. Identify new applications of supercritical fluid technology for extraction of minor alkaloids.

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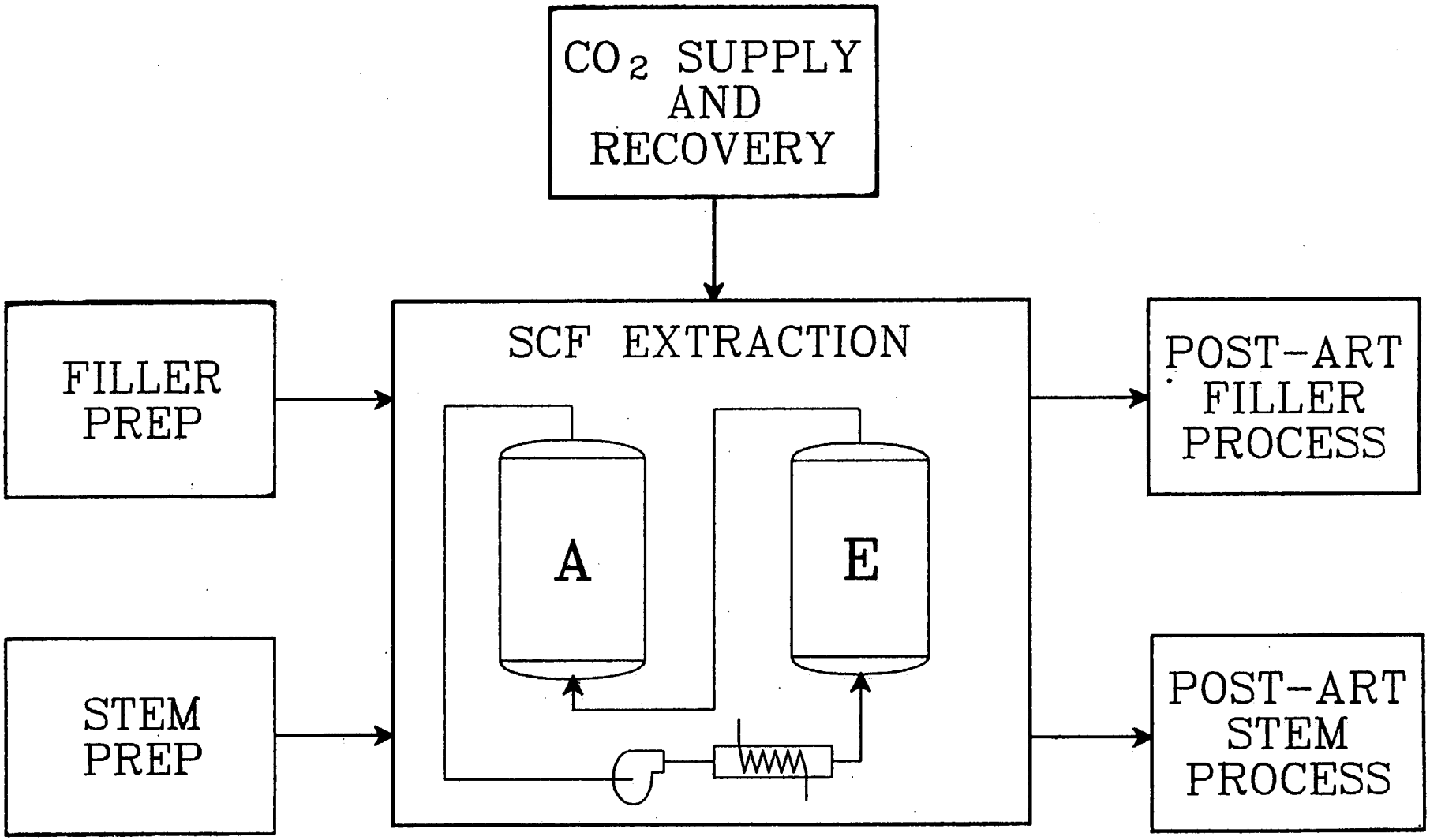
ART PROCESSES



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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ART
PROCESS DEVELOPMENT

Objective:

Develop Commercial Supercritical CO_2 Process to Remove 97 percent of the Extractable Nicotine from Tobacco.

Strategies - 1988-89:

1. Determine Best Process Conditions for Selected Blend, to meet Commercial Process Criteria.

2. Establish Analytical Methodology to Determine Extraction Efficiency On-Line.

3. Develop Pre- and Post-ART Filler Processes.

4. Develop Pre- and Post-ART Stem Process.

5. Provide Support to Commerical Plant Engineering and Operations Groups.

6. Assure Pilot Plant's Safe, Efficient, and Flexible Operation.

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Strategies - 1989-92:

7. Optimize the SCF Process for Nicotine Extraction, Leading to Second Generation Process.

8. Develop a Continuous Extraction Process.

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Strategy:

Determine Best Process Conditions...

Tactics:

1. Operate Lab Facility to Evaluate Process Changes, in Support of Pilot Plant Operation.	OCT 1988
2. Conduct Pilot Plant Experiments to Define Commercial Process for Selected Blend.	OCT 1988
3. Reduce Process ΔP to Reduce Extraction Time.	DEC 1988
4. Optimize Absorber Efficiency.	OCT 1988

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ONE-LITER LABORATORY ACTIVITIES TO SUPPORT PILOT PLANT AND COMMERCIAL DEVELOPMENT

- Temperature Studies
- Reduced Potassium Citrate
- Partition Coefficients
- Citric Acid

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ART PROCESS

- Acid-Base Chemistry, using Supercritical CO_2 as the Solvent to Extract and Move Nicotine.

- Extraction is a Function of:

  - Starting Nicotine Level
  - Filler pH vs Stem pH
  - Filler Titratable Acidity
  - lbs Stem/lb Filler
  - lbs CO_2/lb Tobacco (M/M Ratio)
  - Extractor vs Absorber Temperature
  - Pressure

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CURRENT ART PROCESS CONDITIONS

Extraction Temperature:	140°F
Ammonium Bicarbonate on Filler:	2.5% DWB
Potassium Citrate on Stems:	12.0% DWB
Filler OV:	25-27%
Stem OV:	34-36%
lbs CO_2/lbs Tobacco:	200
lbs Stem/lbs Filler:	1

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PROCESS ΔP REDUCTION

- Alternate Screen Designs
- Stem Cuts/Inch and Length
- Stem OV

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ABSORBER EFFICIENCY OPTIMIZATION

- Reduced Potassium Citrate
- Alternates to Potassium Citrate
- Reduced Stem Requirements
- Effect of Stem Nicotine Level

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RESULTS OF POTASSIUM CITRATE REDUCTION TESTS

Potassium Citrate Added, %	OV, %	Extraction, %
17.3	31.9	97
16.6	38.6	98
16.5	31.9	96
12.4	32.4	97
11.8	31.2	97
11.7	34.7	98
8.2	39.6	96
7.9	32.9	95
7.5	35.2	97
0	39.1	76

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CITRIC ACID ON CRS ABSORBER

Citric Acid %	M/M	Nicotine Extraction %
2.4	200	96
5.3	200	97
8.3	200	98
10.1	200	98
7.4	164	97
7.8	170	97

° DL Blend

° 2.5% AB Target

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Strategy:

Establish Analytical Methodology to Determine Extraction Efficiency On-Line

Tactics:

1. Complete Applied Automation, Inc. Feasibility Study.	AUG 1988
2. Complete In-House Study of Optical Techniques.	AUG 1988
3. Install and Evaluate Commercial-Grade Monitor in Pilot Plant.	JAN 1988

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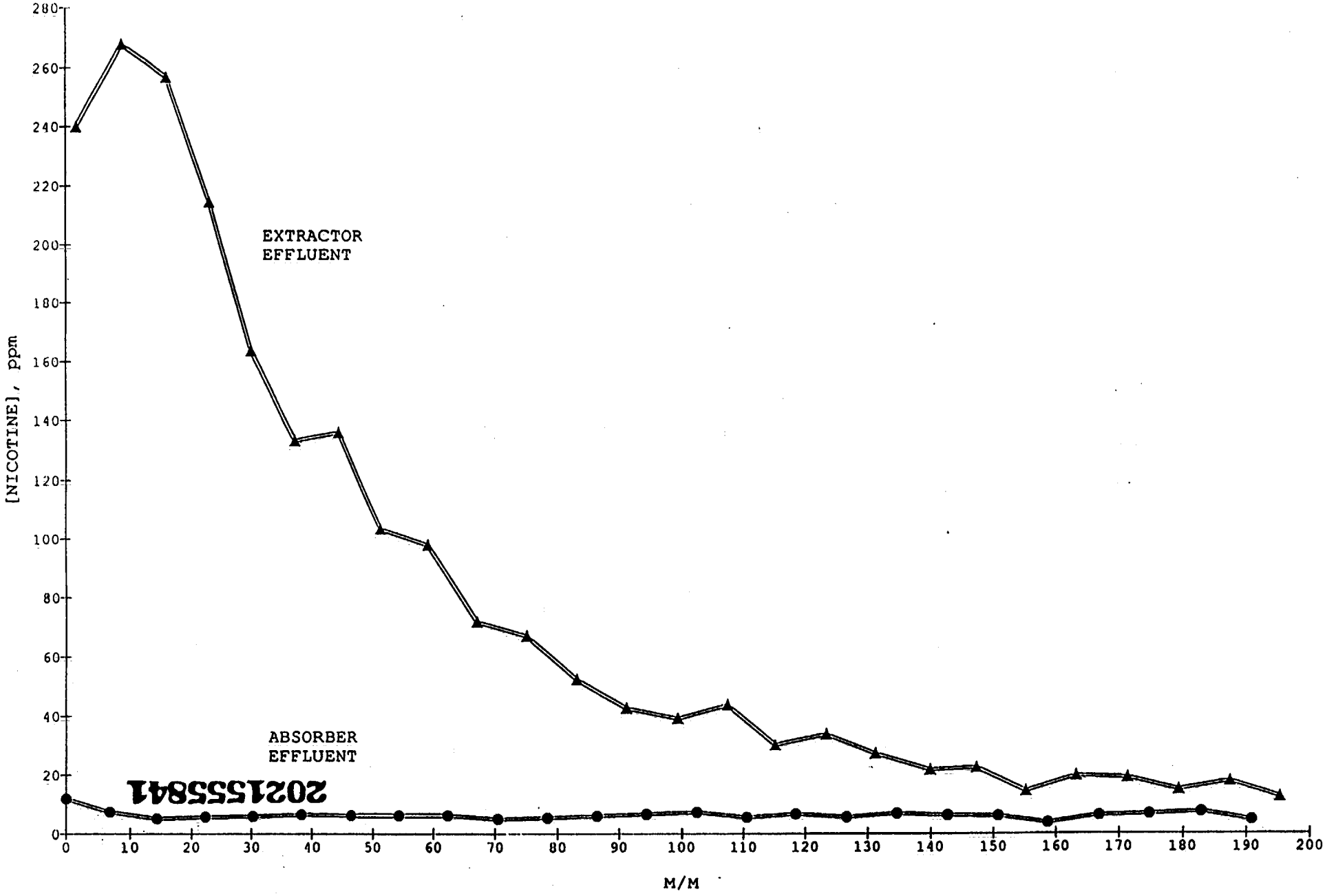
NICOTINE MONITOR OUTPUT



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Strategy:

Provide Support to Commercial Plant.

Tactics:

1. Evaluate Scrubber Carbon Treatment.	JUL 1988
2. Provide Process Training to Supervisory Personnel.	DEC 1988
3. Provide Startup Support.	JAN-JUN 1988

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Strategy:

Assure Pilot Plant Capability to Simulate the Commercial Process.

Tactics:

1. Develop Predictive Model for Extraction. — OCT 1988

2. Develop Thermodynamic Model of Supercritical Process, and Implement Changes to Avoid Wax Layers and Hydrate Region. — JAN 1988

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Strategy:

Complete the Development of Pre- and Post-ART Tobacco Processes.

Tactics:

1. Develop Methods to Remove and Treat Clumped Filler from Extraction Vessels.	SEPT 1988
2. Conduct Pilot Plant and Semiworks Trials to Verify Process and Product Designs	MAR 1989

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FILLER PREPARATION STEPS

Strip	12 % OV
↓	
Conditioner	14 %
↓	
Steam Cylinder	16 %
↓	
Separator	
↓	
Silo	
↓	
AB Application Cylinder	21 %
↓	
Cutter	
↓	
Surge Silo	
↓	
AB Application Cylinder	26 %
↓	
Silo	
↓	
Extraction	

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FILLER CASING/DRYING

Extraction	25-28 % OV
↓	
Casing	28-32 %
↓	
Drying	12-13 %
↓	
Aftercut	13-14 %

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Strategy:

Complete the Development of Pre- and Post-ART Stem Processes.

Tactics:

1. Produce IS and RL Products for Subjective Evaluations, and Determine Acceptable Levels of Inclusion.	DEC 1988
2. Conduct Pilot Plant Trials to Verify Adequacy of Commercial Design.	DEC 1988

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Strategy:

Optimize the Process for Removal of Nicotine, Leading to a Second-Generation Supercritical CO_2 Process.

Tactics:

1. Operate Lab Facility to Establish Preliminary Feasibility of Continuous Liquid Scrubber. AUG 1988

2. Establish Subjective Feasibility.

3. Establish Preliminary Process Parameters.

4. Evaluate Nicotine Disposal Options, and Demonstrate Feasibility of Selected Option.

5. Develop Pilot Plant Design for Liquid Scrubber.

6. Install a Pilot Liquid Scrubber Column including Nicotine Disposal System.

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Strategy:

Develop a Continuous Extraction Process.

Timetable:

1992

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ART RESOURCE ALLOCATION

Division	Prof.	Tech.	Total
Product Development	1.0		1.0
Flavor Development	3.0		3.0
Product Evaluation	4.0	1.6	5.6
Development Engineering	1.0	1.0	2.0
Tobacco Materials	9.0	8.0	17.0
Tobacco Processing	2.5	5.6	8.1
Biochemical Research	0.3		0.3
Physical Research	4.0	1.0	5.0
Analytical Research	3.0	6.0	9.0
Chemical Research	1.7		1.7
Computer Applications	3.1	0.3	3.4
Administrative Services	1.4	1.6	3.0
Technical Information	0.9	0.3	1.2
Totals	34.9	25.4	60.3

Resource Need:

Development Team for Nicotine Disposal Process.

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

RECEIVED
JUN 0 6 1988
CLIFF LILLY

To: .Mr. A. C. Lilly **Date:** June 6, 1988

From: .H. Alonso

Subject: .ART PROGRAM PLAN

CONFIDENTIAL

Attached is an updated version of the ART Program Plan. There are no major changes in the plan, other than a narrowing of the scope for long-term objectives, to include only alkaloid reduction in the ART Program. (The previous version included investigation of other applications of supercritical fluid processes as part of ART). In addition, plans for test market production were deleted.

Hector Alonso

/jsa

cc: Dr. J. Charles
Dr. R. Ferguson
Mr. D. Knudson
Mr. W. Kuhn
Mr. J. Myracle
Mr. R. Prasad
Mr. H. Spielberg
Dr. J. Whidby

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OBJECTIVE	STRATEGY	TACTIC	TIME
1. Product Development Develop products with subjective character equal to or better than price/ value brands, such as Doral, from filler which has had 97% of its nicotine extracted with supercritical CO_2.	1.1 Determine optimum blend to meet the 97% extraction goal under commercially feasible process conditions, and best subjective character.	1.1.1 Identify best blend and cigarette design for commercial product.	2nd QTR 1988
		1.1.2 Evaluate impact of process parameters on product quality (i.e., stem type, process parameters, pH, stem inclusion, pre-post-ART processing).	Ongoing
		1.1.3 Identify optimum process parameters for best flavor (i.e., wet casing, after cut flavors, post-ART treatment).	4th QTR 1987
	1.2 Develop cigarette models to accomplish lowest combination of nicotine-in-smoke deliveries and best subjective character.	1.2.1 Develop conventional cigarette models using ART tobacco with FTC tar ranging from 6 to 16 mg in regular and menthol versions.	1st QTR 1988
		1.2.2 Develop cigarette models using ART filler in "novel" construction, i.e., low density rod, different papers and various filters, i.e., charcoal, paper, poly propylene, etc.	4th QTR 1988

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Rev. 6/6/88

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	1.3 Assist marketing with package development and support internal and external product and packaging test requirements, including test markets.	1.3.1 Provide analytical and subjective support for packaging and consumer testing studies.	3rd & 4th QTR 1988
	1.4 Provide support for brand introduction and commercial operation.	1.4.1 Provide on-site subjective support during "start up".	4th QTR 1988 & 1st QTR 1989
	1.5 Explore alternate applications of supercritical fluid technology, to provide significant improvement in subjectives and/or new product introduction.	1.5.1 Provide subjective and analytical support.	Ongoing
2. Process Development Develop commercial supercritical CO_2 process to remove 97% of the extractable nicotine from filler.	2.1 Determine best processing conditions for selected blend, to meet commercial process criteria.	2.1.1 Operate lab facility to evaluate process changes, in support of the pilot plant operation.	4th QTR 1988
		2.1.2 Operate pilot plant to define commercial process for selected blends. a. Determine appropriate combination of AB, M/M, and temperature. b. Evaluate effects of temperature differences between extractor and absorber.	4th QTR 1988

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Rev. 6/6/88

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	2.1.3 Reduce process ΔP to reduce extraction time.	2nd QTR 1988
	a. Evaluate screen designs.	
	b. Evaluate different stem absorber cuts per inch.	
	c. Evaluate absorber OV.	
	2.1.4. Optimize absorber efficiency.	2nd QTR 1988
	a. Evaluate alternatives to potassium citrate.	
	b. Evaluate low background nicotine stem.	
	c. Evaluate OV gradient in stem bed.	
2.2 Establish analytical methodology to define extraction efficiency.	2.2.1 Develop on-line process monitor to determine point of optimum extraction of nicotine.	
	a. Complete Applied Automation, Inc. feasibility study.	3rd QTR 1988
	b. Complete in-house feasibility study.	3rd QTR 1988
	c. Install on-line process monitor(s) in pilot plant operation.	4th QTR 1988

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	d. Evaluate commercials version of on-line monitor in pilot plant.	1st QTR 1988
2.3 Provide support to Commercial Plant.	2.3.1 Complete development of on-line nicotine monitor.	1st QTR 1989
	2.3.2 Provide process and safety training for Commercial Plant personnel.	3rd QTR 1988
	2.3.3 Provide startup support.	1st QTR 1989
	2.3.4 Evaluate carbon thermal treatment.	
2.4 Assure the pilot plant capability to simulate commercial process.	2.4.1 Develop correlation factors to standardize 1 liter lab runs.	3rd QTR 1988
	2.4.2 Develop predictive model for extraction, based on filler chemical properties.	4th QTR 1988
	2.4.3 Develop thermodynamic model of supercritical process.	4th QTR 1988
2.5 Complete the development of pre- and post-ART tobacco processes.	2.5.1 Operate Semiworks and to conduct tests to verify commercial design.	4th QTR 1988
2.6 Complete development of of pre- and post-ART stem process.	2.6.1 Complete development of processes to prepare and use Bright CRS as absorbers.	2nd QTR 1988

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	2.6.2 Evaluate alternate stem types and utilization for process/product impact.	4th QTR 1989
	2.6.3 Continue support of pilot plant via production of treated stems.	Ongoing
2.7 Optimize the process for the removal of nicotine from tobacco, leading to a second-generation super-critical extraction process for tobacco.	2.7.1 Operate lab facility to establish preliminary feasibility of continuous liquid scrubber.	3rd QTR 1988
	2.7.2 Establish subjective feasibility.	3rd QTR 1988
	2.7.3 Establish preliminary process parameters.	3rd QTR 1988
	2.7.4 Evaluate nicotine disposal options. Demonstrate feasibility of selected option (ion exchange, membrane, conventional waste water treatment or other options).	4th QTR 1988
	2.7.5 Develop pilot plant process design for	3rd QTR 1989
	2.7.6 Complete design of pilot plant scale water column.	2nd QTR 1989
	2.7.7 Install a flexible design water column including nicotine disposal system. nicotine disposal.	4th QTR 1989

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	2.8 Develop a continuous tobacco extraction process.	2.8.1 Demonstrate early feasibility on laboratory scale.	2nd QTR 1990
		2.8.2 Design and construct a continuous pilot plant/ process.	2nd QTR 1991
		2.8.3 Evaluate process/product attributes of a continuous design.	4th QTR 1992
3. Explore New Applications	3.1 Identify at least one new application of supercritical fluid extraction technology to tobacco processing, for minor alkaloid reduction.	3.1.2 Evaluate process on laboratory scale to demonstrate feasibility.	4th QTR 1990

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .Mr. A. C. Lilly **Date:** February 29, 1988

From: .H. Alonso

Subject: .ART PROGRAM OPERATIONAL PLAN

Attached is the ART Program Plan for 1988-1992.

Hector Alonso

Attachment

cc: Mr. D. B. Knudson
Mr. R. Prasad
Mr. H. L. Spielberg
Mr. J. F. Whidby
Mr. E. B. Sanders

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ART PROGRAM OBJECTIVES

1. Develop products with best subjectives from filler which has had 97% of its nicotine extracted with supercritical CO_2.

2. Develop commercial supercritical CO_2 process to remove 97% of the extractable nicotine from filler.

3. Explore new applications of supercritical fluid technology, leading to at least one feasible application to tobacco processing.

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ART PROGRAM

STATUS AND BACKGROUND

JANUARY 1988

During 1986 and 1987, laboratory trials at R&D and at Kaffee Hag in Germany demonstrated the feasibility of producing an acceptable cigarette from alkaloid-reduced filler using supercritical CO_2 as the solvent and stems as the absorber.

Engineering work began in 1986 on the design and construction of a commercial facility capable of producing alkaloid-reduced filler to support a market of 12 billion cigarettes per year, and on the construction of the ART Pilot Plant for further process development work to support the commercial process.

The pilot plant came on-stream in August of 1987. The first series of pilot plant trials were aimed at answering engineering design questions for the commercial plant. The bulk of these trials have been completed. The pilot plant's priorities have now shifted toward supporting product development efforts to select the appropriate blends and process conditions to meet the program goals of 97 percent extraction and best subjectives.

Most of the process development and laboratory activity in 1988 is geared toward the completion of the development of the commercial process and product. Startup for the plant is scheduled for January 1989, and a significant level of R&D support is anticipated through the second quarter of 1989.

For the remainder of the plan period (1989 - 1992), process development activities will concentrate in the areas of process optimization, for the commercial operation, and development of a second generation supercritical extraction process. Activities in the Physical Research Laboratory will be geared toward development of process models for supercritical extraction, and on the identification of new applications of supercritical extraction processes for tobacco.

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OBJECTIVE	STRATEGY	TACTIC	TIME
1. Product Development Develop products with subjective character equal to or better than price/ value brand such as Doral, from filler which has had 97% of its nicotine extracted with supercritical CO_2.	1.1 Determine optimum blend to meet the 97% extraction goal under commercially feasible process conditions, and best subjective character.	1.1.1 Identify best blend and cigarette design for commercial product.	2nd QTR 1988
		1.1.2 Evaluate impact of process parameters on product quality (i.e., stem type, process parameters, pH, stem inclusion, pre-post-ART processing).	Ongoing
		1.1.3 Identify best process parameters for improved flavor (i.e., wet casing, after cut flavors, post-ART treatment).	
	1.2 Develop cigarette models to accomplish lowest combination of nicotine-in-smoke deliveries and best subjective character.	1.2.1 Develop conventional cigarette models using ART tobacco with FTC tar ranging from 6 to 16 mg in regular and menthol versions.	1st QTR 1988
		1.2.2 Develop cigarette models using ART filler in "novel" construction, i.e., low density rod, different papers and various filters, i.e., charcoal, paper, poly propylene, etc.	4th QTR 1988

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	1.3 Assist marketing with package development and support internal and external product and packaging test requirements, including test markets.	1.3.1 Provide analytical and subjective support for packaging and consumer testing studies.	3rd & 4th QTR 1988
	1.4 Provide support for brand introduction and commercial operation.	1.4.1 Provide on-site subjective support during "start up".	4th QTR 1988 & 1st QTR 1989
	1.5 Explore alternate applications of supercritical fluid technology, to provide significant improvement in subjectives and/or new product introduction.	1.5.1 Provide subjective and analytical support.	Ongoing
2. Process Development Develop commercial supercritical CO_2 process to remove 97% of the extractable nicotine from filler.	2.1 Determine best processing conditions for selected blend, to meet commercial process criteria.	2.1.1 Operate lab facility to to evaluate new blends and process changes, in support of the pilot plant operation.	4th QTR 1988
		2.1.2 Operate pilot plant to define commercial process for selected blends.	4th QTR 1988
		2.1.3 Investigate sources of unextractable nicotine in filler.	2nd QTR 1988
	2.2 Complete development of commercial supercritical extraction process.	2.2.1 Operate pilot plant to determine commercial process engineering design criteria.	3rd QTR 1988

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2.3 Assure the pilot plant capability to simulate commercial process.	2.3.1 Identify and implement equipment upgrade requirements for pilot plant.	4th QTR 1989
	2.3.2 Develop correlation factors to standardize 1 liter lab runs to pilot plant runs.	3rd QTR 1988
	2.3.3 Develop predictive model for extraction, based on filler chemical properties.	4th QTR 1988
	2.3.4 Develop thermodynamic model of supercritical process.	4th QTR 1989
2.4 Complete the development of pre- and post-ART tobacco processes.	2.4.1 Operate Semiworks and C Pilot Plant to firm up commercial design.	4th QTR 1988
	2.4.2 Further optimize the commercial process to improve quality/reduce cost.	4th QTR 1989
2.5 Complete development of of pre- and post-ART stem process.	2.5.1 Complete development of processes to prepare and use Bright CRS as absorbers.	2nd QTR 1988

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	2.5.2 Evaluate alternate stem types and utilization for process/product impact.	4th QTR 1989
2.6 Transfer process technology to commercial operations staff.	2.6.1 Provide training support for commercial plant operating personnel.	4th QTR 1988
	2.6.2 Operate pilot plant to train operating personnel.	4th QTR 1988
2.7 Optimize the process for the removal of nicotine from tobacco, leading to a second-generation super-critical extraction process for tobacco.	2.7.1 Operate lab facility to establish preliminary feasibility.	3rd QTR 1988
	2.7.2 Establish preliminary cost/quality parameters.	3rd QTR 1988
	2.7.3 Evaluate nicotine disposal options. Demonstrate feasibility of selected option (IX, membrane, other).	4th QTR 1988
	2.7.4 Develop pilot plant process design for nicotine disposal.	1st QTR 1989
	2.7.5 Complete design of pilot plant scale water column.	2nd QTR 1989
	2.7.6 Install a flexible design water column including nicotine disposal system.	4th QTR 1989

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		2.7.7 Evaluate quality/cost parameters of a water absorption process.	2nd QTR 1990
		2.7.8 Recommend next steps.	4th QTR 1990
	2.8 Develop a continuous tobacco extraction process.	2.8.1 Demonstrate early feasibility on laboratory scale.	2nd QTR 1990
		2.8.2 Design and construct a continuous pilot plant.	2nd QTR 1991
		2.8.3 Evaluate process/product attributes of a continuous design.	4th QTR 1992
3. Explore New Applications	3.1 Identify at least one new application of supercritical fluid technology to tobacco processing.	3.1.1 Screen and evaluate several alternatives for the application of supercritical technology to tobacco processing (i.e., flavor extraction transfer, menthol application, selective TSNA removal, etc.).	1st QTR 1989
		3.1.2 Evaluate selected process on laboratory scale, leading to one or two candidates with potential.	4th QTR 1990
		3.1.3 Demonstrate early feasibility in the lab of selected process.	2nd QTR 1991

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ART PROGRAM RESOURCE REQUIREMENTS SUMMARY

05-Feb-88

DIVISION	1988		1989		1990		1991		1992	
	PROF.	TECH.	PROF.	TECH.	PROF.	TECH.	PROF.	TECH.	PROF.	TECH.
TOBACCO MATERIALS	8.0	8.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0	4.0
PHYSICAL RESEARCH	4.0	1.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0
FLAVOR DEVELOPMENT	1.0		1.0		1.0		1.0		1.0	
PRODUCT DEVELOPMENT	1.0		1.0		1.0		1.0		1.0	
TOBACCO PROCESSING & FABRICATION	2.0	7.0	2.0	7.0	2.0	7.0	2.0	7.0	2.0	7.0
ANALYTICAL RESEARCH	1.0	8.0	1.0	8.0	1.0	8.0	1.0	8.0	1.0	8.0
BIOCHEMICAL RESEARCH	0.3		0.3		0.3		0.3		0.3	
CHEMICAL RESEARCH	1.7		0.5		0.5		0.5		0.5	
PRODUCT EVALUATION	0.3		0.3		0.3		0.3		0.3	
DEVELOPMENT ENGINEERING	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL:	20.3	25.0	17.1	22.0	17.1	22.0	17.1	22.0	17.1	22.0
GRAND TOT.= PROF.+TECH.		45.3		39.1		39.1		39.1		39.1

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Reduced Density Rod

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Nov. 14, 1988

From the desk of:

Ed Craze

RECEIVED
NOV 14 1988
CLIFF LILLY

To: Cliff,

There are no major changes to be made to the Low Density Rod program. However, the following items have been included in our plans &

1) Pectin coating ART filler to improve spotting.
2) LDR cigs. packed in mentholated foil.
3) Make Tomorrow samples in Marlboro configuration.
4) Make LDR cigs. with 100% Flue-cured tobacco (Australian cigs).

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Ed

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PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: . Mr. R. S. Mullins Date: October 18, 1988

From: . W. L. Mokarry

Subject: . Low Density Rods - Steam Residence Time Study

PURPOSE: To determine the effect of steam residence time on the physical quality of low density rod cigarettes. Steam residence time is defined as the length of time the filler is exposed to steam for binder reactivation before entering the microwave cavity.

CONCLUSIONS: Even at the lowest steam residence time (0.37 seconds), a good quality bonded rod was produced. For low density rods, firmness appears to be a function of tobacco weight and maker speed, but not steam residence time (over the range tested). Loose ends appear to be affected by steam residence time, as well as by cigarette weight and rod circumference. The circumference effect, however, is negative, with lower circumference values yielding greater loose ends fallout. These circumference and maker speed effects could indicate degradation of filler and/or bonds at the wrapper or tipper.

RECOMMENDATIONS: Tests should be run to study the effects of circumference variation on firmness and loose ends. A program should be initiated to determine the effect of the tipper on the quality of low density cigarettes. Also, since any relationship between maker speed and cigarette firmness would have implications for scale-up of the maker, this relationship should be further investigated.

PROCEDURE: The tobacco used in this study was blended, cased all lamina filler with a 6% add-on of a 2% undegraded Genu L200 pectin solution. Three cigarette parameters were varied during the test: tobacco weight, maker speed, and steam injection location. Two tobacco weights were run - low (575 mg) and high (650 mg). Three maker speeds were used - 650, 1000, and 1350 cpm. And two steam injection points were designed - near (480 mm from the microwave cavity) and far (950 mm from the microwave cavity).

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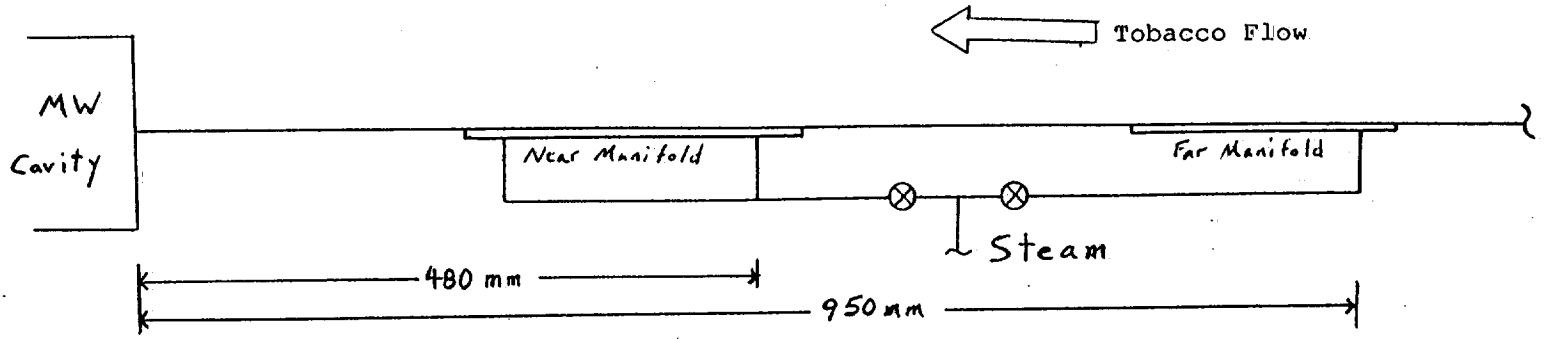

The above sketch shows the steam piping layout. Two valves were added to the steam piping to allow flow changes without stopping the maker. For the near location, steam is injected into a manifold via two injection ports. The further of these two points was chosen as the best representative value for the location at which the steam is present in sufficient quantities to begin binder reactivation. The far location also has steam injected into a manifold. However, only one injection port is used here. The location of the injection port is again used as the best estimate for the point at which enough steam is present to initiate binder reactivation.

The combinations of speed and distance yielded a range of residence times of 0.37 to 1.54 seconds (see Table 1). Three replications were made for each condition, and all conditions were randomized. Cigarettes were equilibrated and tested for firmness and loose ends.

RESULTS: Firmness and loose ends values are summarized in Table 1. When firmness data are plotted versus steam residence times (Figure 1), it appears that the residence time has an effect on firmness. However, if the residence time data are broken down to speed and distance parameters, a plot of firmness versus maker speed (Figure 2) yields no differences due to steam injection location. Step-wise multiple regression (equation shown in Figure 3) indicates that the factors affecting firmness are tobacco weight and maker speed[1]. This is somewhat surprising, since previous analyses showed no firmness difference when maker speed was increased from 750 to 1000 cpm[2]. However, a much larger range of speeds was examined in this study. Alternatively, the randomization of the test, with continual changes in speed over short periods of time, may have prevented the maker operating conditions from being optimized at each speed. Thus, the observed maker speed effect may be artificial.

Loose ends data, plotted in Figure 4, show a trend of increased steam residence time yielding lower tobacco fallout. When these data are plotted against maker speed with steam injection location contours (Figure 5), it is apparent that both location and speed affect loose ends results. Stepwise multiple regression (equation shown in Figure 6) indicates that steam residence time, cigarette weight, and circumference significantly affect loose ends fallout[3]. The overall regression is not especially good (R^2 =

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[1] Lab Notebook 8651, pp 71 - 76.
[2] Douglas, S. Notebook 8709 pp 5 - 12.
[3] Lab Notebook 8651, pp 77 - 82.

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0.722). One factor influencing this poor fit is the small range of loose ends values achieved.

The effect of circumference on loose ends is surprising in that the result is negatively correlated. That is, smaller circumference is seen to yield larger tobacco fallout. This is opposite of previous experience with standard cigarettes. A possible explanation for this reversal is that at the smaller circumferences, tobacco shreds or the bonds between the shreds are broken due to excess compression. Studies are planned to examine this hypothesis.

cc: Mr. H. Alonso
Mr. E. G. Craze
Mr. W. E. Claflin
Ms. S. Douglas
Mr. D. B. Knudson
Mr. A. C. Lilly
Ms. K. J. Merideth
Mr. H. B. Merritt
Mr. H. X. Nguyen
Mr. W. A. Nichols
Ms. M. E. Toerne
Mr. W. D. Winterson

Central Files

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TABLE 1

Steam Residence Times

Distance from Microwave Cavity (mm)	Maker Speed (cpm)	Residence Time (sec)
480	650	0.78
	1000	0.51
	1350	0.37
950	650	1.54
	1000	1.00
	1350	0.74

57 mm rods

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TABLE 2

Steam Residence Time Study
Firmness/Loose Ends Data

		Low Speed/Near Injection/Low Weight		
Filler Weight	mg	567	574	555
OV	%	11.90	12.12	12.43
Circumference	mm	24.89	24.80	24.80
Rod Density	g/cc	0.202	0.206	0.199
Maker Speed	cpm	650	650	650
Steam Residence Time	sec	0.78	0.78	0.78
Distance from Microwave	mm	480	480	480
Firmness	mm	3.02	2.90	2.93
Cigarette Weight	g/50 cigts	41.13	41.83	41.29
Loose Ends	g	0.15	0.16	0.16

		Low Speed/Near Injection/High Weight		
Filler Weight	mg	633	643	633
OV	%	12.19	12.32	12.24
Circumference	mm	24.86	24.82	24.97
Rod Density	g/cc	0.226	0.230	0.224
Maker Speed	cpm	650	650	650
Steam Residence Time	sec	0.78	0.78	0.78
Distance from Microwave	mm	480	480	480
Firmness	mm	2.29	2.11	2.28
Cigarette Weight	g/50 cigts	45.26	45.54	44.9
Loose Ends	g	0.14	0.10	0.10

		Medium Speed/Near Injection/Low Weight		
Filler Weight	mg	569	578	548
OV	%	12.30	12.27	12.10
Circumference	mm	24.86	24.65	24.88
Rod Density	g/cc	0.203	0.210	0.195
Maker Speed	cpm	1000	1000	1000
Steam Residence Time	sec	0.51	0.51	0.51
Distance from Microwave	mm	480	480	480
Firmness	mm	2.94	2.69	3.09
Cigarette Weight	g/50 cigts	41.51	41.78	40.55
Loose Ends	g	0.12	0.17	0.20

		Medium Speed/Near Injection/High Weight		
Filler Weight	mg	627	635	632
OV	%	12.29	12.16	12.33
Circumference	mm	24.84	24.92	24.94
Rod Density	g/cc	0.224	0.225	0.224
Maker Speed	cpm	1000	1000	1000
Steam Residence Time	sec	0.51	0.51	0.51
Distance from Microwave	mm	480	480	480
Firmness	mm	2.34	2.28	2.29
Cigarette Weight	g/50 cigts	45.04	44.96	44.63
Loose Ends	g	0.10	0.11	0.10

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Table 2
(continued)

		High Speed/Near Injection/Low Weight		
Filler Weight	mg	548	574	553
OV	%	12.23	12.27	12.14
Circumference	mm	24.62	24.74	24.76
Rod Density	g/cc	0.199	0.207	0.199
Maker Speed	cpm	1350	1350	1350
Steam Residence Time	sec	0.37	0.37	0.37
Distance from Microwave	mm	480	480	480
Firmness	mm	3.21	3.25	3.03
Cigarette Weight	g/50 cigts	40.87	40.54	40.71
Loose Ends	g	0.22	0.26	0.15

		High Speed/Near Injection/High Weight		
Filler Weight	mg	644	632	636
OV	%	12.19	12.11	12.16
Circumference	mm	24.90	24.60	24.86
Rod Density	g/cc	0.229	0.230	0.227
Maker Speed	cpm	1350	1350	1350
Steam Residence Time	sec	0.37	0.37	0.37
Distance from Microwave	mm	480	480	480
Firmness	mm	2.26	2.34	2.40
Cigarette Weight	g/50 cigts	44.41	45.16	45.06
Loose Ends	g	0.15	0.20	0.17

		Low Speed/Far Injection/Low Weight		
Filler Weight	mg	553	538	543
OV	%	12.19	12.14	12.32
Circumference	mm	24.72	24.78	24.80
Rod Density	g/cc	0.200	0.193	0.195
Maker Speed	cpm	650	650	650
Steam Residence Time	sec	1.54	1.54	1.54
Distance from Microwave	mm	950	950	950
Firmness	mm	2.87	2.99	3.01
Cigarette Weight	g/50 cigts	40.97	40.99	40.66
Loose Ends	g	0.08	0.08	0.09

		Low Speed/Far Injection/High Weight		
Filler Weight	mg	649	637	648
OV	%	12.24	12.36	12.06
Circumference	mm	24.79	24.82	24.81
Rod Density	g/cc	0.233	0.228	0.232
Maker Speed	cpm	650	650	650
Steam Residence Time	sec	1.54	1.54	1.54
Distance from Microwave	mm	950	950	950
Firmness	mm	2.12	2.21	2.02
Cigarette Weight	g/50 cigts	45.98	45.18	45.58
Loose Ends	g	0.08	0.06	0.06

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Table 2
(continued)

		Medium Speed/Far Injection/Low Weight		
Filler Weight	mg	567	563	565
OV	%	12.18	12.15	12.09
Circumference	mm	24.73	24.80	24.67
Rod Density	g/cc	0.204	0.202	0.205
Maker Speed	cpm	1000	1000	1000
Steam Residence Time	sec	1	1	1
Distance from Microwave	mm	950	950	950
Firmness	mm	2.87	2.93	2.80
Cigarette Weight	g/50 cigts	41.54	41.25	41.16
Loose Ends	g	0.13	0.13	0.10

		Medium Speed/Far Injection/High Weight		
Filler Weight	mg	647	646	631
OV	%	12.23	12.47	12.24
Circumference	mm	24.80	24.51	24.85
Rod Density	g/cc	0.232	0.237	0.225
Maker Speed	cpm	1000	1000	1000
Steam Residence Time	sec	1	1	1
Distance from Microwave	mm	950	950	950
Firmness	mm	2.17	2.15	2.21
Cigarette Weight	g/50 cigts	45.73	45.02	45.16
Loose Ends	g	0.12	0.10	0.08

		High Speed/Far Injection/Low Weight		
Filler Weight	mg	561	555	562
OV	%	12.20	12.22	12.15
Circumference	mm	24.78	24.49	24.61
Rod Density	g/cc	0.201	0.204	0.204
Maker Speed	cpm	1350	1350	1350
Steam Residence Time	sec	0.74	0.74	0.74
Distance from Microwave	mm	950	950	950
Firmness	mm	3.12	3.16	3.06
Cigarette Weight	g/50 cigts	41.04	41.12	40.75
Loose Ends	g	0.18	0.21	0.16

		High Speed/Far Injection/High Weight		
Filler Weight	mg	642	633	620
OV	%	12.29	12.14	12.25
Circumference	mm	24.90	24.64	24.76
Rod Density	g/cc	0.228	0.230	0.223
Maker Speed	cpm	1350	1350	1350
Steam Residence Time	sec	0.74	0.74	0.74
Distance from Microwave	mm	950	950	950
Firmness	mm	2.30	2.27	2.53
Cigarette Weight	g/50 cigts	45.07	45.13	44.67
Loose Ends	g	0.13	0.15	0.13

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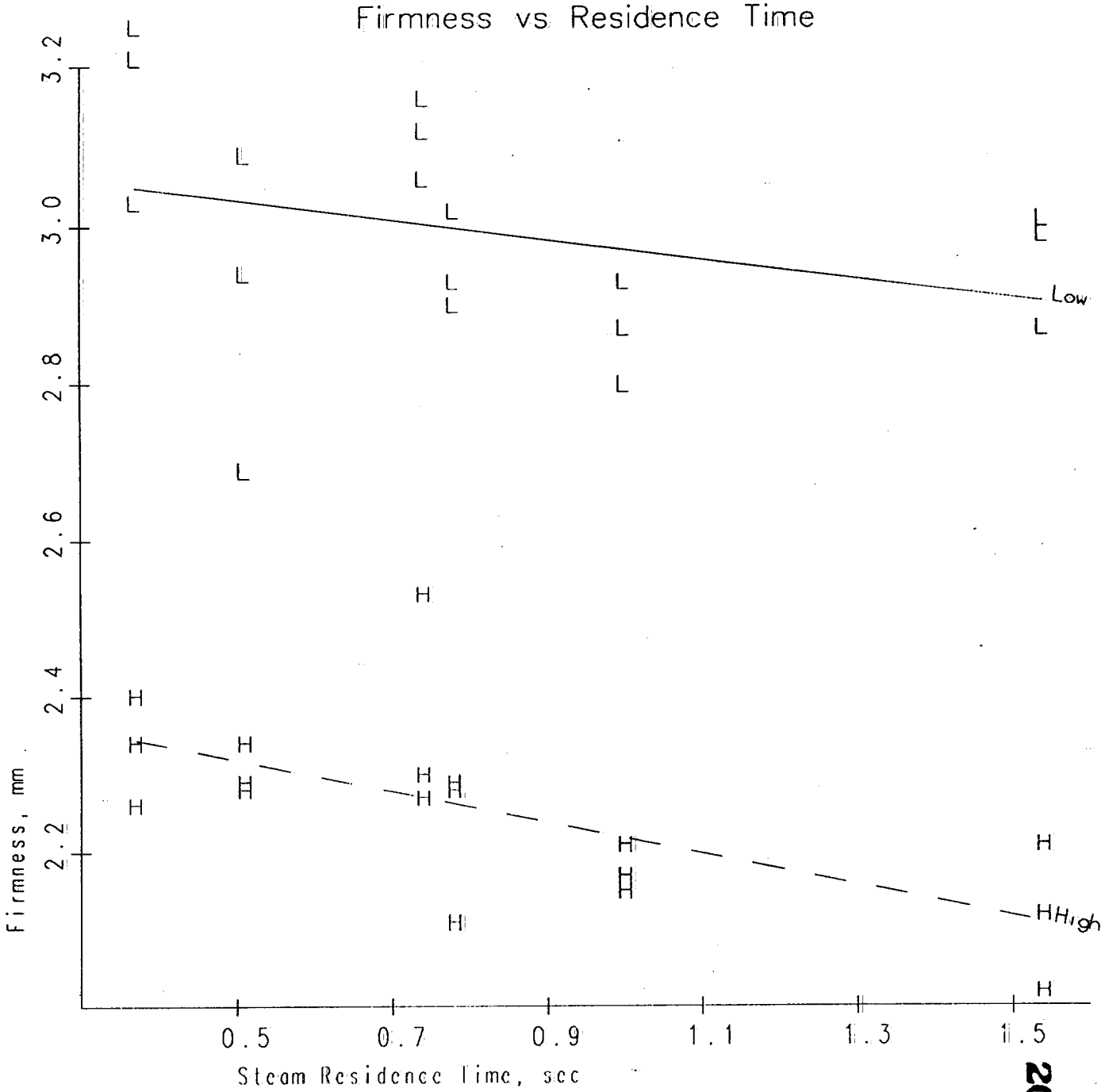
FIGURE 1

Steam Residence Time Study

Firmness vs Residence Time



	N	R	SD	COE0	COE1
L=Low Weight	18	0.3363	0.1397	3.095	-0.1244
H High Weight	18	0.6643	0.09037	2.419	-0.2003

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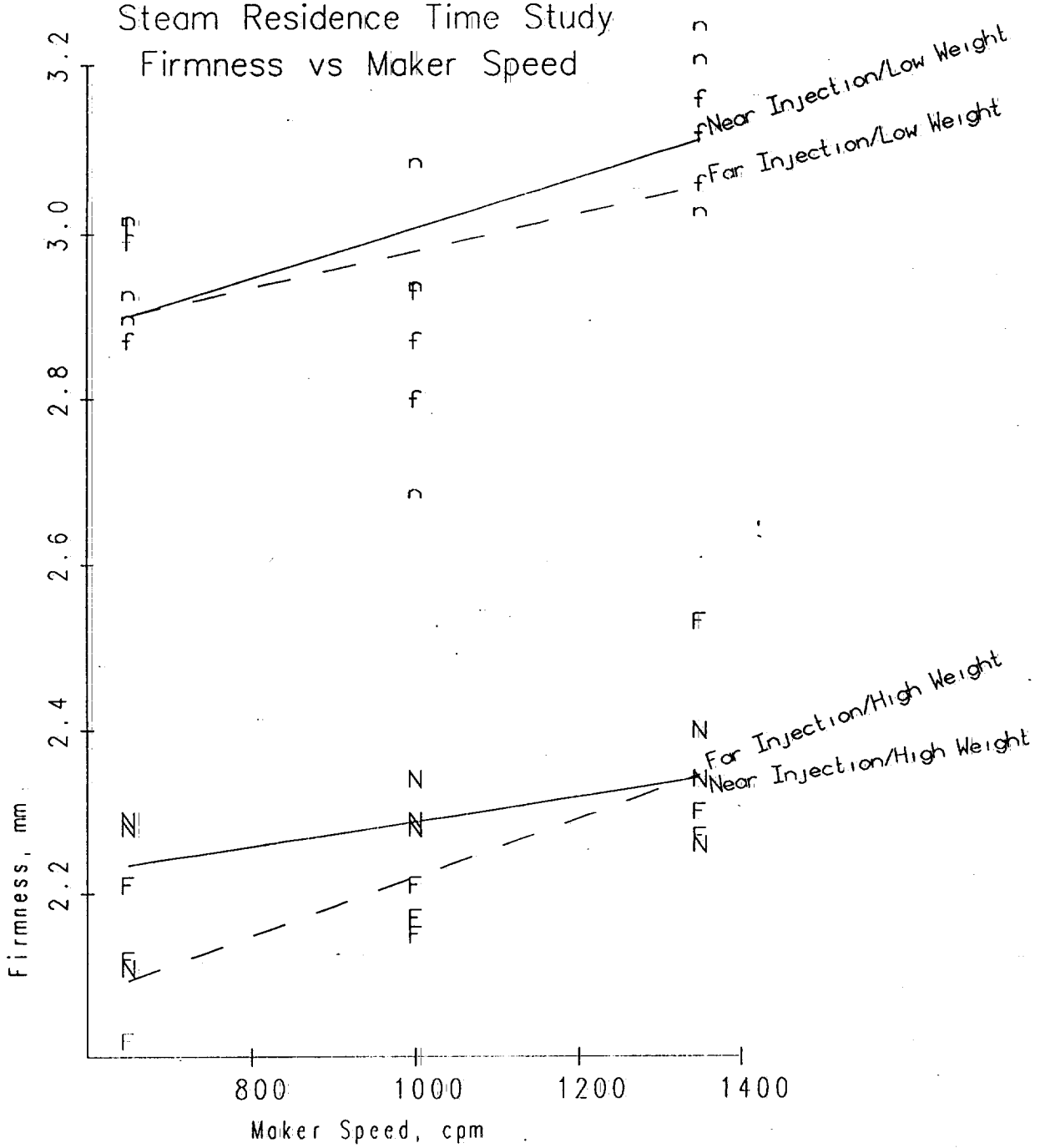
FIGURE 2

Steam Residence Time Study

Firmness vs Maker Speed



	N	R	SD	COE0	COE1
n=Near Injection/Low Weight	9	0.5446	0.1521	2.702	0.0003048
N High Weight	9	0.581	0.06917	2.135	0.0001524
f=Far Injection/Low Weight	9	0.5574	0.108	2.755	0.0002238
F High Weight	9	0.7593	0.09918	1.863	0.0003571

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07/2: 88

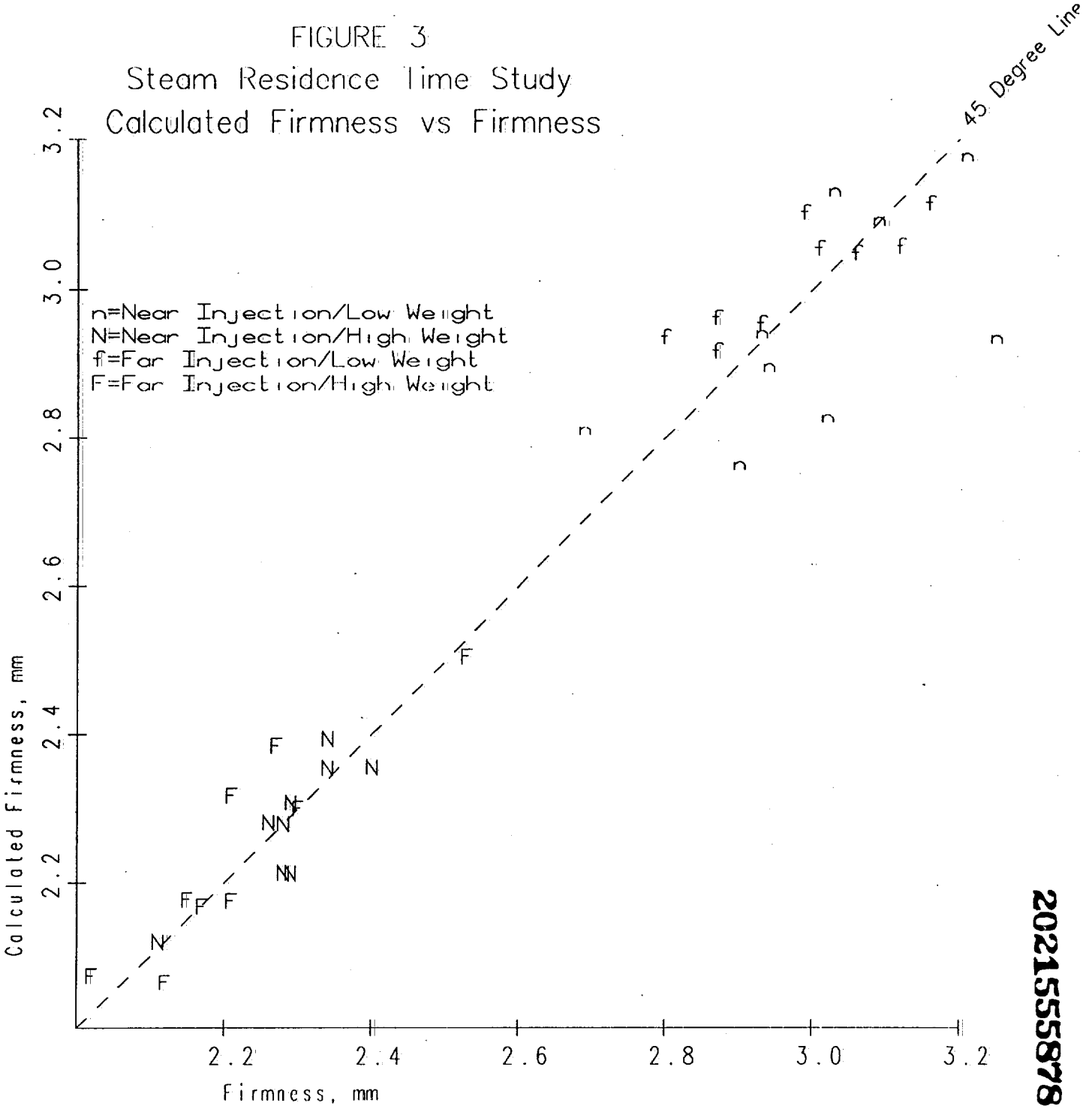
FIRSPE1

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

FIGURE 3

Steam Residence Time Study

Calculated Firmness vs Firmness



Calculated Firmness = 7.9809 − .0009363(Tobacco Weight)
+ 0.000245(Maker Speed)

R2 = 0.949 SD = 0.9219

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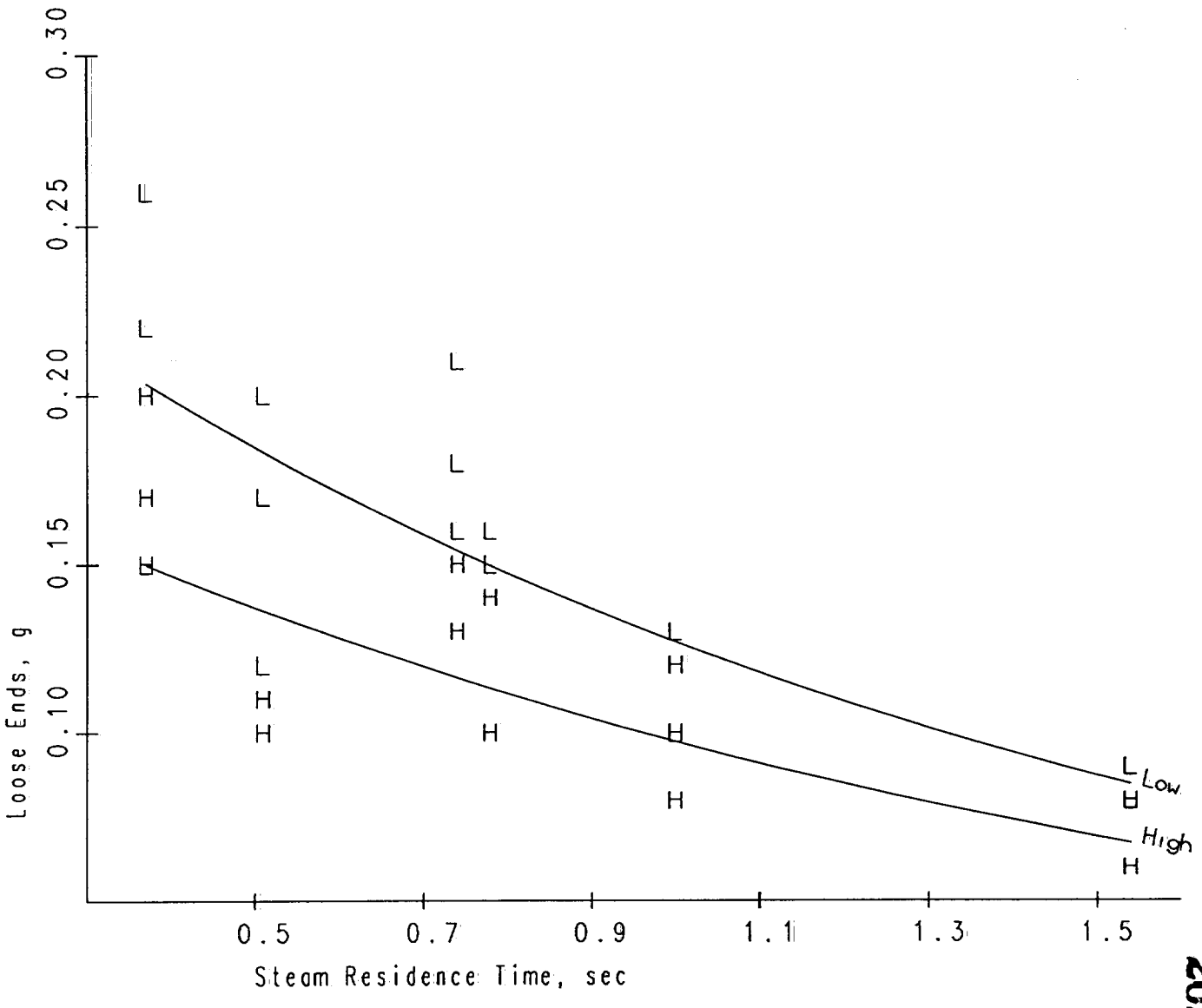
CALFIRM2

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

FIGURE 4

Steam Residence Time Study

Loose Ends vs Residence Time



	N	R	SD	LSD	INT	SLOPE
L=Low Weight	18	0.851	0.1853	0.03029	-1.315	-0.7488
H High Weight	18	0.8081	0.2	0.02416	-1.644	-0.6842

LN Y= INT + SLOPE#X

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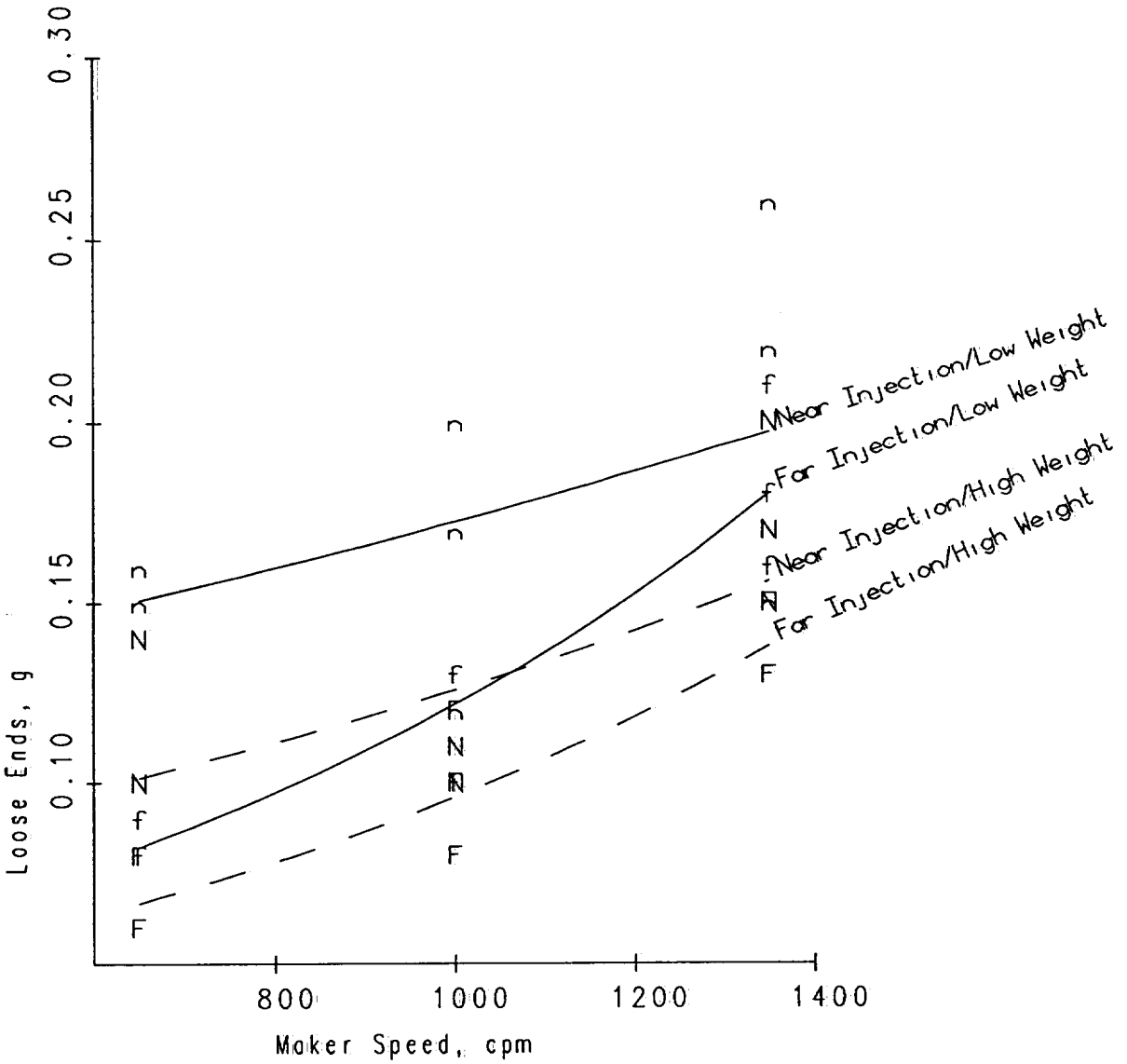
Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

FIGURE 5

Steam Residence Time Study

Loose Ends vs Maker Speed



	N	R	SD	LSD	INT	SLOPE
n=Near Injection/Low Weight	9	0.4996	0.2151	0.03603	-2.141	0.0003828
N High Weight	9	0.695	0.2064	0.0256	-2.689	0.0006156
f=Far Injection/Low Weight	9	0.9523	0.1162	0.01572	-3.225	0.00112
F High Weight	9	0.9145	0.1485	0.01315	-3.378	0.001036

LN Y= INT + SLOPE#X

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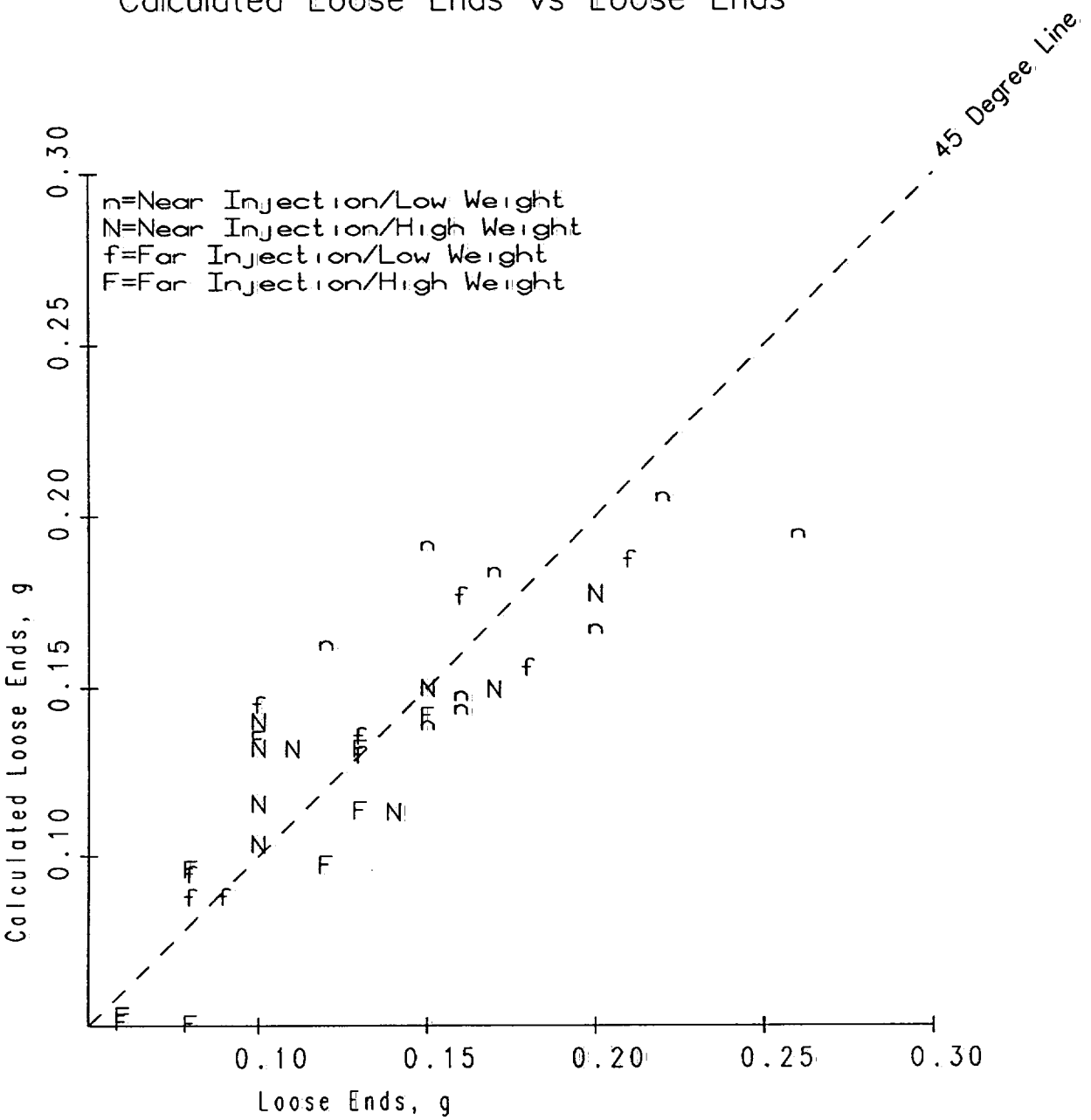
Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

FIGURE 6

Steam Residence Time Study

Calculated Loose Ends vs Loose Ends



Calculated Loose Ends = 3.2438 − 0.08569(Steam Residence Time)
− 0.00728(Cigarette Weight) − 0.11(Circumference)

R2 = 0.7223 SD = 0.02603

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08/03

CALLE2

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CONFIDENTIAL

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: D. B. Knudson **Date:** July 13, 1988

From: E. G. Craze

Subject: Reduced Density Rod Program

Attached is an updated developmental plan for the Reduced Density Rod program. The plan divides the program into five major parts; Binder Technology, Binder Application, Reduced Density Cigarette Making, Product Development and Commercialization. Resource requirements include the entire Tobacco Fundamentals Division (10 professionals, 7 technicians) and impacts on all Divisions within R&D. Total R&D personnel resources are estimated to be 39 people per year through 1989. In addition, significant PM USA Engineering resources (to be defined by Engineering) will be required for scale-up and commercialization of the process and associated equipment.

With the program being product driven, the critical path involves; 1) product definition, 2) design, fabrication and development of a high speed making complex and 3) design and installation of the commercial process. It is estimated that product advantages will be verified and a potential product will be defined by the end of the first quarter, 1989. Once commercial product viability has been established, work will be initiated with Engineering to scale-up the cigarette making process and define commercialization requirements.

The commercialization date for a reduced density product is estimated to be during 1992 and is highly dependent upon the commitment towards scale-up and commercialization of the process.

Attachment

cc: Directors
Managers
A. C. Lilly
P. Martin
R. Mullins
W. Nichols

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

REDUCED DENSITY ROD PROGRAM

PROGRAM GOAL

Develop a process to produce reduced density cigarettes having unique market advantages. The process will utilize a binding agent on the filler.

BACKGROUND

Reduced density cigarettes are expected to provide unique market advantages in taste, quality, economics and social acceptance. A process has been identified which utilizes binder technology to bond tobacco shreds together to produce a tobacco rod that has a higher void volume and enhanced physical properties. The higher void volume is expected to alter the subjective response by changing the rod filtration efficiency and draw characteristics of the cigarette. Physical advantages of the bonded tobacco network are improved firmness, less tendency for tobacco to fall out and more efficient tobacco utilization.

The Reduced Density Rod process consists of several steps. The cut filler is first coated with an aqueous pectin solution with simultaneous drying. The material is then fed to a maker where the binder is activated with steam, heated and dried with microwave energy, and then cooled with forced air before cutting and tipping. The current developmental process is based upon a modified Mark-8 maker, runs at low speed (1,000 cpm) and uses filler coated with pectin in a batch mode. By the end of 1988 plans are to refine the maker, i.e., improve the activation, drying, and cooling steps. Work will also be conducted to develop a continuous scalable binder application process.

During 1988 we also plan to produce cigarette models for Product Development that will demonstrate the specific utilities of the process to programs such as Low Tar/High Flavor, Reduced Sidestream, ART and Tomorrow. Once scalable making and coating processes have been demonstrated and product advantages have been established, work will be initiated to commercialize the process for the manufacture of new products.

OBJECTIVES

1. Develop tobacco binding technology and identify the most appropriate binder for use in the production of reduced density cigarettes.

2. Develop a continuous scalable process for applying binder materials to tobacco filler.

3. Develop the equipment and associated process for the production of reduced density cigarettes.

4. Define the advantages of reduced density cigarettes and develop related new products.

5. Evaluate pilot operation for producing reduced density cigarettes and defining commercialization requirements.

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MAJOR TASKS

1. **BINDER TECHNOLOGY**

   A. Establish Pectin Specifications
   B. Develop Binder Performance Test
   C. Evaluate Processing Variables
   D. Evaluate Alternate Binders

2. **BINDER APPLICATION**

   A. Evaluate Potential Processes
   B. Develop Most Appropriate Process
   C. Develop Casing/AC Application
   D. Finalize Pilot Process Design Specifications
   E. Design and Construct Pilot System
   F. Define Commercial Process
   G. Produce Coated Filler for Maker/Product Development

3. **REDUCED DENSITY CIGARETTE MAKING**

   A. Define Reduced Density Rod Making Process
   B. Refine Making Process
   C. Evaluate On-Maker Binder Application
   D. Develop/Evaluate High Speed Maker
   E. Define Commercial Making Process
   E. Design and Fabricate High Speed Maker Complex
   F. Produce Cigarettes for Product Development

4. **PRODUCT DEVELOPMENT**

   A. Identify Advantages of Reduced Density Cigarettes
   B. Define Specific Target Product
   C. Assess Commercial Viability
   D. Develop New Product Candidates
   E. Develop Flavor/Casing Systems
   F. Investigate Effects of Reduced Density Process on Existing Product

5. **PROCESS COMMERCIALIZATION**

   A. Evaluate Pilot Operation
   B. Conduct Economic Analysis
   C. Design/Fabricate Commercial Maker
   D. Design/Fabricate Commercial Coater

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

RESOURCE REQUIREMENTS

KEY	RESPONSIBILITY/SUPPORT GROUPS	Estimated Current Personnel Requirements[1] Prof.	Tech.	Total
TF	Tobacco Fundamentals	10.0	7.0	17.0
TM	Tobacco Materials	1.2	1.0	2.2
AR	Analytical Research	1.0	0	1.0
PR	Physical Research	1.0	0	1.0
FD	Flavor Development	1.0	0	1.0
CD	Cigarette Development	1.0	0	1.0
CT	Cigarette Technology	0.4	0.1	0.5
CTG	Cigarette Testing	0.5	1.5	2.0
TP	Tobacco Processing and Fabrication	1.0	2.3	3.3
PE	Product Evaluation	1.5	0.6	2.1
CR	Chemical Research	1.0	0	1.0
DE	Development Engineering	1.5	0.5	2.0
BR	Biochemical Research	0	0	0
AS	Administrative Services	1.0	1.0	2.0
CA	Computer Applications	2.1	0.2	2.3
TI	Technical Information	0.6	0.2	0.8
ENG	PM USA Engineering	*	*	*
	Totals	24.7	14.5	39.2

1. Personnel requirements through 1989 are estimated to be relatively constant with emphasis shifting towards product development and engineering scale up.

* Personnel requirements will be defined by PM USA Engineering.

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RESPONSIBILITY MATRIX - BINDER TECHNOLOGY

RESPONSIBILITY/SUPPORT GROUPS

	TASKS	TF	TM	AR	PR	FD	CD	CT	CTG	TP	PE	CR	DE	BR	AS	ENG
A.	Establish Pectin Specifications	O	X	O	O	O					O	O		O		
B.	Develop Binder Performance Test	X	O		O								O			
C.	Evaluate Processing Variables	O		O												
D.	Evaluate Alternate Binders	O	X	O	O	O				O	O	O		O		

X Designates primary responsibility; others are support responsibilities.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

RESPONSIBILITY MATRIX - BINDER APPLICATION

RESPONSIBILITY/SUPPORT GROUPS

	TASKS	TF	TM	AR	PR	FD	CD	CT	CTG	TP	PE	CR	DE	BR	AS	ENG
A.	Evaluate Potential Processes	X	O	O	O	O			O	O		O	O		O	O
B.	Develop Most Appropriate Process	X	O						O	O			O		O	O
C.	Define Casing/AC Application	X	O			O				O						
D.	Finalize Pilot Process Design Specifications	X	O										O			O
E.	Design and Construct Pilot System	O											X		O	O
F.	Define Commercial Process	O	O										O			X
G.	Produce Coated Filler For Maker/Product Development	X	O							O						

X Designates primary responsibility; others are support responsibilities.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

RESPONSIBILITY MATRIX - REDUCED DENSITY CIGARETTE MAKING

		RESPONSIBILITY/SUPPORT GROUPS													
		TF	TM	AR	PR	FD	CD	CT	CTG	TP	PE	CR	DE	BR	AS	ENG
	TASKS															
A.	Define Making Process	X											O			
B.	Refine Making Process	X								O			O		O	
C.	Evaluate On-Maker Binder Application	X	O							O			O		O	O
D.	Develop/Evaluate High Speed Maker	O														X
E.	Define Commercial Making Process	O											O			X
F.	Produce Cigarettes for Product Development	X				O	O	O		O						

X Designates primary responsibility; others are support responsibilities.

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RESPONSIBILITY MATRIX - PRODUCT DEVELOPMENT

RESPONSIBILITY/SUPPORT GROUPS

	TASKS	TF	TM	AR	PR	FD	CD	CT	CTG	TP	PE	CR	DE	BR	AS	ENG
A.	Identify Advantages of Reduced Density Cigarettes	O		O	O	O	O	X	O			O				
B.	Define Specific Target Product	O	O			O	O	X	O		O					
C.	Assess Commercial Viability	O	O			O	O	X	O		O					
D.	Develop New Product Candidates	O	O		O	O	O	X		O	O					
E.	Develop Flavor/Casing Systems	O	O	O		X	O					O				
F.	Investigate Effects of RDR on Existing Products	O			O	O	O	X			O					

X Designates primary responsibility; others are support responsibilities.

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RESPONSIBILITY MATRIX - PROCESS COMMERCIALIZATION

	TASKS	RESPONSIBILITY/SUPPORT GROUPS													
		TF	TM	AR	PR	FD	CD	CT	CTG	TP	PE	CR	DE	BR	AS	ENG
A.	Evaluate Pilot Operation	X		O		O			O	O	O	O		O		O
B.	Conduct Economic Analysis	O[1]														O
C.	Design/Fabricate Commercial Maker	O				O	O						O			X
D.	Design/Fabricate Commercial Coater	O				O	O						O			X

X Designates primary responsibility; others are support responsibilities.

1. Finance will have major responsibility for economic analysis.

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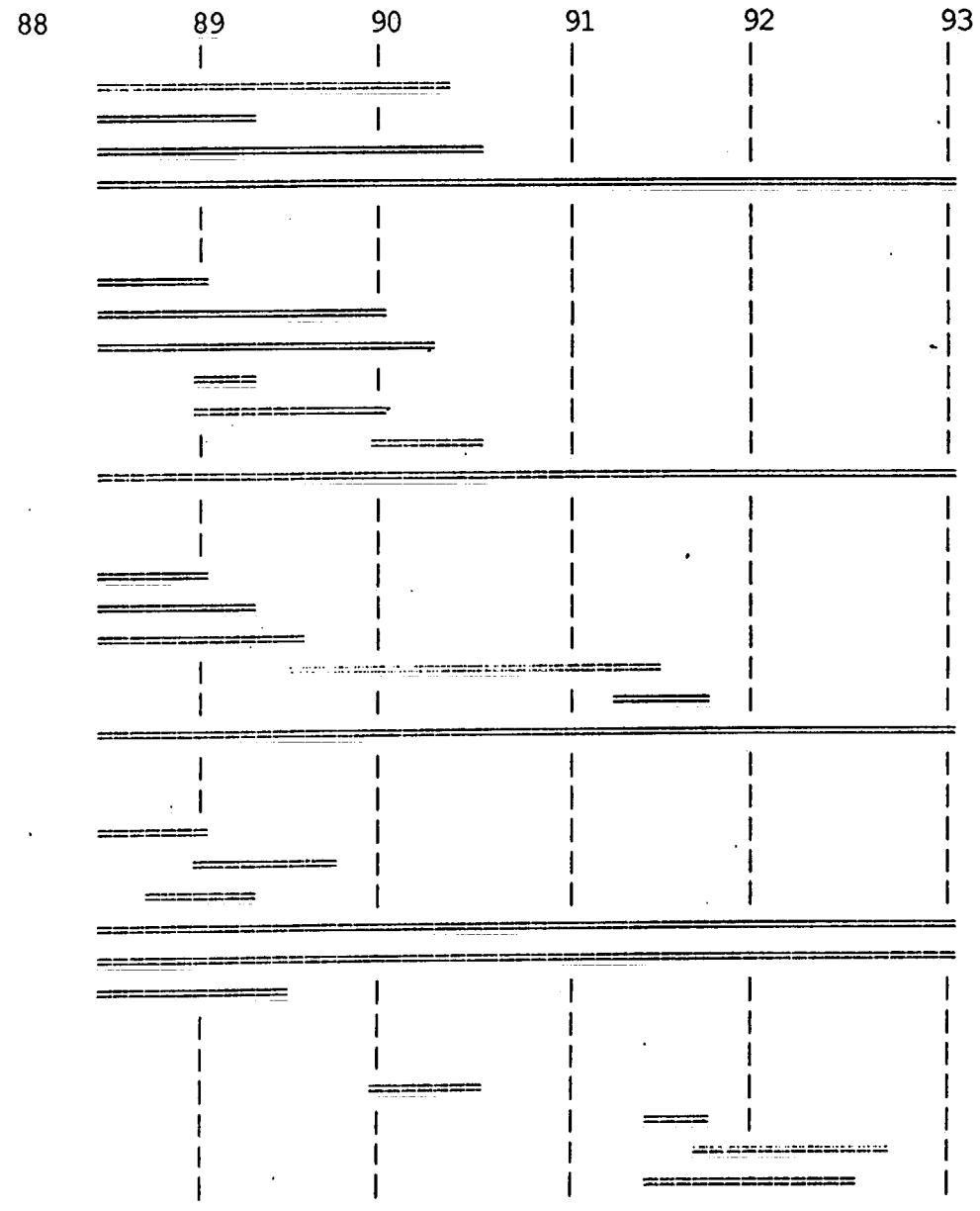
Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

LOW DENSITY ROD PROGRAM SCHEDULE



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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

REDUCED DENSITY ROD OBJECTIVE AND BACKGROUND

The objective of this program is to provide commercial products that offers PM unique market advantages and utilize binder technology within the cigarette. This objective will be achieved through several strongly interconnected programs, LOW DENSITY ROD, FOAM BOUND ROD and BONDED ENDS.

The LOW DENSITY ROD program will require the bulk of the resources and with Engineering support could provide test market quantities of several unique products with subjective, social, quality and/or economic advantages in 1991. These will capitalize on the greatly reduced tobacco density (>25% reduction) which modifies the filtration efficiency of the rod to produce a cigarette with different subjective impact, allow delivery control through the filter and permit a lower mass burn rate.

The low density cigarette making process, based upon a modified Mark 8 maker, is currently running at low speeds (1000 cpm) and the filler is coated with pectin in a batch mode. By the end of 1988 we hope to increase the maker speed, and improve the activation, drying and cooling steps. We will also evaluate the feasibility of applying the pectin in a continuous coating reel. During the same time period it should be possible to produce prototype cigarette models for Product Development. It is intended to do baseline studies that will confirm the utility of this process, and set priorities on the various product applications.

Once information is available on product priorities and a continuous coating process, a decision will be needed on how to implement both making and coating processes on a commercial scale.

The FOAM BOUND ROD program will reach a product decision point by September 1988 and promises limited quality and economic improvements on conventional products although the Foam technology may present an attractive alternative for casing or flavoring cigarettes.

The BONDED ENDS program will again provide limited quality and economic improvements for conventional cigarettes and will reach a major process decision point during 1988. Commercialization will then be the prime responsibility of Engineering although R&D will be able to provide the necessary knowledge of binder technology to support implementation.

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STRATEGIES

1. Determine which aspects of the Low Density Rod offer positive product opportunities.

2. Determine a scalable process to continuously coat filler with pectin.

3. Set up a scalable continuous coating line that will provide adequate quantities of coated filler to support test production on high speed equipment.

4. Develop the current low speed equipment to address concerns on activating, drying, cooling and wrapping prototype product.

5. Investigate alternative means of applying binder to the filler.

6. Determine how flavors and casings are effected by the current process and develop strategies to effectively apply these additives.

7. Determine impact of CV/OV/size on product physical characteristics.
8. Determine best approach to developing high speed production and provide support based upon our low speed maker experience.

9. Determine the physical and chemical characteristics of both binder and substrate that lead to an effective bound rod.

10. Determine if binders other than pectin can be used effectively on our products.

11. Identify the utility of the current Foam Bound Rod product for the USA market.

12. Investigate the addition of flavors or casings through a foam injection nozzle in the hopper.

13. Provide support for International utilization of the Foam Bound Rod Process.

14. Evaluate alternative approaches to binding tobacco at the end of the cigarette.

15. Investigate what range of physical firmness parameters, both lit and unlit, are important to people when they handle and smoke a cigarette.

16. Routine operations.

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TACTICS FOR STRATEGY 1 - LOW DENSITY PRODUCT EVALUATION

Abbreviations: mm = man months
prof = professional
tech = technician
FD = Flavor Development
TF = Tobacco Fundamentals
PD = Product Development

1.1 Carry out the parameter evaluation test with G. Keritsis.

Time: 6 months
Start: 1/88
Resources: TF 1.5 prof mm + 1.5 tech mm--available
PD 1 prof--available
Cigt Testing - physical smoking analytical 30 samples
FD - subjectives on 30 samples

1.2 Investigate the role of predicted smoke composition changes for LT/HT program with H. Spielberg.

Time: 9 months
Start: 1/88
Resources: TF 4.5 prof mm + 3 tech mm--available
FD 1 person--probable conflicts
Cigt Testing - total evaluation of 24 samples
Subjectives on 24 samples

1.3 Investigate whether LDR can provide a product with reduced sidestream and acceptable smoking characteristics.

Time: 8 months
Start: 1/88
Resources: TF 2 prof mm + 1.5 tech mm--available
Chem Res 4 mm--available
Cigt Tech 1 person--possible conflicts
Cigt Testing - total evaluation of 24 samples
Subjectives on 24 samples

1.4 Investigate how LDR can influence Project Tomorrow

Time: 6 months
Start: After 1.1
Resources: TF 2 prof mm + 1.5 tech mm--available
Cigt Tech 1 person--possible conflicts
Cigt Testing - total evaluation of 24 samples
Phy Res 3 mm--available
Subjectives on 24 samples

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1.5 Investigate whether LDR can have a positive impact on ART from either subjectives or tobacco utilization

Time: 9 months
Start: 1/88
Resources: TF 3 prof mm + 2 tech mm
FD or PD 1 + persons--possible conflicts
Cigt Testing - total evaluation of 24 samples
Subjectives on 24 samples

1.6 Assign priorities to the programs competing for TF resources.

Time: 2 weeks
Start: After all previous tactics are underway

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TACTICS FOR STRATEGY 2 - SCALEABLE CONTINUOUS COATING PROCESS

2.1 Installation

Time: 2 months
Status: Complete
Start: Now
Resources: Process Dev or Admin Svcs--available

2.2 Assessment of Feasibility
Gas Velocity Effects
Fluidization
Spray Coating
Cylinder Operation
New Cylinder Design

Time: 8 months
Start: After 2.1
Resources: TF 4 prof mm + 4 tech mm--available

2.3 Testing of Coated Material

Time: 1 month
Start: After 2.2
Resources: TF 1.5 prof mm + 1 tech mm--available
Cigt Testing - total evaluation 6 samples
Subjectives on 6 samples

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TACTICS FOR STRATEGY 3 - SCALEABLE PROTOTYPE CONTINUOUS COATING LINE

3.1 Preliminary Design

Time:	1 month
Start:	After Strategy 2 complete
Resources:	TF 1 prof mm--available
	Dev Eng 1 prof mm

3.2 Order Equipment

Time:	2 months
Start:	After 3.1 is complete
Resource:	0.2 prof mm

3.3 Receive and Install Equipment

Time:	10 months (9 to receive, 1 to install)
Start:	After 3.2
Resource:	Proc Dev 1 prof mm

3.4 Modify and Test Equipment

Time:	4 months
Start:	After 3.3
Resource:	TF 3 prof mm + 3 tech mm

3.5 Tobacco Production

Time:	Continuous
Start:	After 3.4
Resource:	TF 2 persons--possible conflict

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TACTICS FOR STRATEGY 4 - DEVELOP CURRENT LOW SPEED EQUIPMENT

4.1 Overhead Suction Transfer Belt

Time: 8 months
Start: 1/88
Resources: TF 1.5 prof mm + 1 tech mm--prof to be hired
Dev Eng 1 prof mm
Machine Shop 2 mm

4.2 Redesign Microwave Cavity to Prevent Tobacco Buildup

Time: 6 months
Start: 1/88
Resource: TF 1 prof mm + 0.5 tech mm available
+ outside consultant
Dev Eng 1 prof mm
Machine Shop 1 mm

4.3 Optimize Steam Activation on Current Equipment

Time: 3 months
Start: 6/88
Resources: TF--1 prof mm + 1 tech mm--prof to be hired
Cigt Testing of 3 samples
Subjectives on 3 samples

4.4 Determine Maximum Production Rate on Current Equipment

Time: 4 months
Start: After 4.1 completed
Resource: TF--1 prof mm + 1 tech mm--possible conflict

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS FOR STRATEGY 5 - ALTERNATIVE BINDER APPLICATION METHODS

5.1 Evaluation of Dry Coating Technique

Time: 3 months
Start: 1/88
Resource: TF 0.5 prof mm + 1 tech mm--available
Cigt Testing of 2 samples
Subjectives on 2 samples

5.2 Investigation of Dry Coating

Time: 4 months if 5.1 positive
Start: After 5.1
Resource: TF 1.5 prof mm + 1.5 tech mm--possible conflict
Cigt Testing of 6 samples
Subjectives on 6 samples

5.3 Investigation of Tower Drying

Time: 2 months
Start: 5/88
Resource: TF 0.5 prof mm--unavailable
Cigt Testing of 3 samples
Subjectives on 3 samples

5.4 Investigation of Fluidized Bed Coating

Time: 6 months
Start: After 5.3
Resource: TF 4 prof mm--unavailable
Cigt Testing of 6 samples
Subjectives on 6 samples

5.5 Application Via Nozzle On Maker

Time: 4 months
Start: 3/88
Resource: TF 1.5 prof mm + 2 tech mm--conflict on both
Cigt Testing of 3 samples
Subjectives on 3 samples

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS FOR STRATEGY 6 - IMPACT OF MATERIAL CONDITIONS ON LOW DENSITY PRODUCT

6.1 Determine and Monitor Variability of Process

Time: 12 months
Start: 1/88
Resources: TF 2 prof mm, 2 tech mm--available
Cigt Testing - 30 samples

6.2 Determine Effect of Changes in CV, OV, And Size

Time: 6 months
Start: 1/88
Resources: TF 1.5 prof mm + 1.5 tech mm--available
Cigt Testing - 30 samples
Subjectives on 6 samples

TACTICS FOR STRATEGY 7 - IMPACT OF PROCESS ON FLAVORS AND CASINGS

7.1 Measure Losses on Current system

Time: 4 months
Start: 4/88
Resources: TF 3 prof mm + 2 tech mm--unavailable
FD 2 mm--unavailable
Analytical support for 10 samples
Subjectives on 10 samples

7.2 Investigation of Other Means of Preserving Flavors and Casings

Time: 3 months
Start: After 7.1
Resource: TF 3 prof mm + 3 tech mm--unavailable
FD 1 mm--unavailable
Analytical support for 20 samples
Subjectives on 20 samples

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS FOR STRATEGY 8 - ALTERNATIVE APPROACHES TO HIGH SPEED PRODUCTION

8.1 Compare Relative merits of R&D, Engineering, Outside Contractors, or Cigarette Maker Development

Time: 1 month
Start: After Strategies 1 and 2
Resources: Engineering input

8.2 Support for High Speed Production

Time: 1 to 1.5 years, depending on source
Start: After 8.1
Resource: TF 12 prof mm--possible

TACTICS FOR STRATEGY 9 - OPTIMAL BINDER AND SUBSTRATE CHARACTERISTICS

9.1 Develop Testing Procedure

Time: 6 months
Start: 1/88
Resources: TF 1 prof mm--available
Phy Res 2 prof mm--only 1 available
Tob Materials 1 prof mm

9.2 Evaluation Alternative Binder Materials

Time: 6 months
Start: After 9.1
Resources: Phy Res 2 prof mm--only 1 available
TF 1 prof mm--available
TM 1 prof mm--available

9.3 Evaluate Role of Substrate and Casing

Time: 6 months
Start: After 9.1
Resources: TF 3 prof mm--available
TM 3 prof mm
Phy Res 3 prof mm

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS FOR STRATEGY 10 - ALTERNATIVE BINDERS

10.1 Laboratory Evaluation of Known Candidates

Time: 12 months
Start: After 9.1
Resources: TF 3 prof mm, 1 tech mm--1 prof to be hired
Analyt Microscopy of 10 samples

10.2 Process Evaluation of Alternative Candidates

Time: 12 months
Start: Now
Resource: 3 prof mm + 2 tech mm--potential conflict
FD subjective evaluation of 20 samples
Cigt Testing evaluation of 20 samples
Tob Mat 2 prof mm

TACTICS FOR STRATEGY 11 - FOAM BOUND ROD EVALUATION

11.1 Evaluation of Low Add-on Levels of Pectin

Time: 4 months
Start: 1/88
Resources: 1 prof mm + 1 tech mm--available
FD subjective eval. of 3 samples
Cigt Testing evaluation of 3 samples

11.2 Economic Evaluation for USA Market Based on Pectin Binder

Time: 1 month
Start: After 11.1
Resource: TF 0.5 prof mm--available

11.3 Alternative Binders

Time: 4 months
Start: After 11.2
Resources: TF 2 prof mm + 2 tech mm--conflicts
FTR data on similar programs
Cigt Testing of 6 samples
Subjectives on 6 samples

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS FOR STRATEGY 12 - FOAM INJECTION OF VOLATIVE COMPONENTS

12.1 Evaluate Menthol Release Compounds in Laboratory

Time: 6 months
Start: 1/88
Resource: TF 0.5 prof mm + 0.5 tech mm--available
FD 1 prof mm
Potential problem with material availability

12.2 Machine Test of Menthol Release Compounds

Time: 2 months
Start: After 12.1
Resources: TF 0.5 prof mm + 0.5 tech mm--possible conflict
FD 1 prof mm
Cigt Testing of 5 samples
Subjectives on 5 samples
Analytical support for 5 samples

TACTICS FOR STRATEGY 13 - INTERNATIONAL SUPPORT ON FBR

13.1 Transfer of Binder, and Process Technology

Time: Ongoing, but not heavy
Resources: TF <1 prof

2021555903

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS FOR STRATEGY 14 - BONDED ENDS

14.1 Develop Ink Jet Technology

Time:	4 months
Start:	1/88
Resources:	Dev Eng 4 prof mm
	TF 0.5 prof mm
	Cigt Testing of 4 samples
	Subjectives on 4 samples

14.2 Develop Molins Foam Application Technique

Time:	4 months
Start:	1/88
Resources:	TF 0.5 prof mm
	Tob Materials 0.5 prof mm
	Engineering 1 prof mm
	Cigt Testing of 6 samples
	Subjectives on 6 samples

14.3 Compare Ink Jet With Foam Technique

Time:	1 month
Start:	After 14.1 and 14.2
Resources:	Dev Eng 1 prof mm
	TF 1 prof mm--possible conflict

14.4 Develop the Chosen Technique for a Product

Time:	1 year
Start:	After 14.3
Resources:	Eng 1 prof mm + 1 tech mm--possible conflict
	Dev Eng 1 prof mm--possible conflict
	TF or TM 1 prof mm
	FD or PD 1 prof--conflict

2021555904

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TACTICS FOR STRATEGY 15 - FIRMNESS MEASUREMENTS AND PERCEPTION

15.1 Evaluate Panel Response to LBR Cigarettes

Time: 2 months
Start: 4/88
Resources: TF 1 prof mm + 1 tech mm
PED 3 panel tests
Semiworks produce 2 control cigarettes
Cigt Testing of 5 samples

15.2 Measure How Smokers Hold the Cigarettes

Time: 3 months
Start: 3/88
Resources: TF 1 prof mm
Dev Eng Support

15.3 Relation to Instron Testing Data

Time: 2 months
Start: After 15.2
Resources: TF 1 prof mm
Phy Res 1 prof mm

TACTICS FOR STRATEGY 16 - ROUTINE OPERATION

16.1 Administration

Start: 1/88
Resources: 1 prof per month
TF 1 mm per month

16.2 Material Processing

Start: 1/88
Resources: 1 prof and 2 techs per month
TF 1 prof mm and 2 tech mm per month

2021555905

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

2021555906

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

RICHMOND, VIRGINIA

RECEIVED
SEP 26 1988
CLIFF LILLY

To: A. C. Lilly

Date: September 26, 1988

From: R. A. Fenner

Subject: Operations Support - Third Quarter Planning Meeting

Attached, please find the third quarter update for Operations Support programs. Please let me know if further information is required.

Attachments

cc: J. Charles
W. Kuhn

R. A. Fenner

2021555907

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SEMIWORKS SUPPORT

Objective: Use a small scale fabrication unit, the Semiworks, to provide cigarette production to evaluate new blends, new processes, new materials and other production related improvements to support PM USA programs.

Status and Plans

1. Support the Marlboro Standardization Program

   Status: Semiworks, as a production facility, participates in the program.

   Plans: Marlboro Standardization VI is scheduled for October 17.

2. Support Flavor Modification Programs

   Status: Support on-going programs.

   Plans: Continue support.

3. Support the Offshore Tobacco Reduction Program

   Status: Blends designed by the Leaf Department are being made.

   Plans: Continue support.

4. Support to Improve the Processing Plants

   Status: Hauni Steam Tunnel Investigation is underway.

   Plans: Continue programs.

5. Support the TLA Program

   Status: Cigarettes from individual leaf grades are being fabricated in the Semiworks.

   Plans: Continue this service.

Resource: 6 persons for 1988. Resources are also required from Analytical and Cigarette Testing.

2021555908

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO SHEET IMPROVEMENTS

Objective: Support efforts to improve the quality of PM USA sheet products by investigating alternate methods of production.

Status and Plans

1. Yankee Release Agents

   Status: Materials have been approved for use. Production from the RL Pilot Plant has been submitted for subjective screening by Flavor Development.

   Plans: Final process and subjective testing at Park 500.

2. Humectant Rearrangement

   Status: Investigations with products made at the Semiworks are complete.

   Plans: Formal factory trials with proposed humectant composition to determine spotting incidence.

   Supply accountability calculations using OV residual basis methods.

3. Dry Flavor Replacement

   Status: Investigations to replace dry flavors with liquid flavors to improve flavor dispersion in RCB and reduce thickening and recycle of size in RL are in place.

   Plans: Implement plans when liquid flavor samples are received from vendors near the end of September. Flavor Development will compound the flavors and evaluate product. What about RCB?

4. Miscellaneous Projects

   Status: Pilot Plant and process development resources have been provided as needed.

   Plans: Continuing program.

Resources: Projected for 1.5 persons in 1988. Resources from Analytical Research, Cigarette Testing, Flavor Development, PED, Semiworks, and the Pilot Plant are also required.

2021555909

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

BURLEY SPRAY

Objective: Determine the level and uniformity of application of burley spray to strip by measuring selected chemical components of the burley spray to support efforts to standardize and/or improve burley spray application.

Status and Plans

1. Determine the Uniformity of Application of Burley Spray

   Status: One run on one line at the M/C has been sampled and sugars used as the marker to measure uniformity.

   Plans: Sample additional runs using the same protocol.

2. Provide Chemical Analyses to Determine Volatile Losses Through the PS Dryer

   Status: Changes in nicotine, propylene glycol and glycerin under normal and GCC PS drying conditions have been measured at one MC line. Results confirmed greater losses of these components under the GCC drying conditions.

   Plans: Sample additional runs as soon as a newly installed mass flow meter is calibrated.

3. Determine the Effect of Extremes in **Normal** PS Dryer Operation on Subjectives and Chemical Components.

   Status: No testing has been performed. Operation Services is developing the test proposal.

   Plans: Perform chemical and subjective testing as described by test proposal.

4. Chemically Characterize the Effect of Various Drying Conditions on the Burley Tobacco/Burley Spray System Under Laboratory Conditions

   Status: No progress has been made on this objective.

   Plans: Design and implement in 1989.

Resource: 1.0 persons remainder of 1988

2021555910

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO MICROBIOLOGY

Objective: Provide support to various PM USA programs in the areas of microorganism populations and alternate processing techniques to reduce organism populations. Develop standard methodology which can be turned over to QA at the appropriate time.

Status and Plans

1. Alternate Humectant Program

   Status: Microbiological populations have been determined on all of the test materials from this program.

   Plans: No additional work anticipated.

2. Leaf Department

   Status: Microbial counts have been made on the hogshead, box, bale storage study for the Leaf Department.

   Plans: Complete study as requested.

3. Miscellaneous

   Status: Bacterial identifications, as requested.

   Plans: Study effects of the removal of potassium sorbate from the RCB process.

Resources: Projected for 5 persons in 1988.

2021555911

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENTOMOLOGY SUPPORT

Objective: Provide entomology support in a timely manner to support PM USA and International efforts in tobacco beetle control and pesticide control. Serve as the experts within the Company to provide assistance in controlling the tobacco beetle and other pests at all locations.

Status and Plans

1. Pesticides

   Status: Support for on-going pest control programs is being provided through information, assistance, education and guidance in choice of pesticide, application rate, frequency, and other current pertinent considerations to appropriate personnel with PM USA and TTG.

   Plans: This is an on-going program and will continue at the current level. Update the acceptable pesticide list.

2. Kabat

   Status: Efforts to assure the uniform application of desired levels at the stemmeries are being supported.

   Plans: Determine Kabat dosage and time required for protection from beetle infestation of stems during storage. Continue to assure methodology compliance at contract laboratory.

3. Fumigation

   Status: Support for on-going program is being provided to appropriate personnel.

   Plans: This is an on-going program, support will continue at the current level.

   Obtain ARS/APHIS approval for phytosanitary certification of export cut filler using Ageless and Isolcel.

   Issue the final report on CO_2 as a fumigant.

4. Related Activities

   Continue to gather data on the distribution of the cigarette beetle as it relates to the processing of tobacco into cigarettes (the supply side of our operation prior to cigarette Making).

   Implement procedures for obtaining data on the distribution of cigarette beetle on the finished product side of our operations.

   Prepare a training video to address cigarette beetle control.

2021555912

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Gather data to determine the efficiency of the pheromone trap.

Devise and test methods to remove the Tyvek bag from processed tobacco (expanded strip, expanded stems, and improved stems).

Resources: Projected 5.0 persons for 1988. Also requires resources from Analytical Research and Flavor Development.

2021555913

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENVIRONMENTAL TOBACCO SMOKE

Objective: To provide PM USA and International Corporate Affairs and Science and Technology with information and technical support to combat proposed legislation to restrict smoking.

Status and Plans

1. CO Measurement

   Status: For an alternative to using electrochemical detectors, a non-dispersive IR is being configured in a portable case.

   Plans: Electrochemical cell and solid state sensors are still being evaluated.

2. Aircraft Studies

   Status: Providing technical assistance for SAS study being conducted by TNO Laboratories.

   Plans: As needed.

3. R&D Field Studies

   Status: Cafeteria study completed.

   Plans: No additional cafeterias to be studied. Plan protocols for Amtrak.

Resources: 6

2021555914

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ANALYTICAL FLAVOR SPECIFICATIONS

Objectives: To develop chemical and physical specifications for current, incoming flavor materials and to transmit specifications and methods for monitoring specifications to appropriate groups by the end of 1989.

Status and Plans

1. Vendor Agreements - continuing.

2. Specifications

   Status: One vendor completed, second vendor in progress.

   Plans: Continue.

3. German Flavors

   Status: Specifications for flavor materials used in German flavors have been completed and transferred to appropriate groups.

   Plans: Implement and streamline the testing of German finished flavors or blends for adherence to current marker profiles and transmit methodology and assistance to QA at appropriate time.

4. Specifications and Methods Transfer

   Status: Specifications are being entered into the QA computer. All incoming material profile (IMP) methods developed have been transferred.

   Plans: Continue to transmit specifications as they are developed. Provide assistance for implementation.

Resources: 4

2021555915

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CUSTOMER COMPLAINTS

Objective: Provide analytical assistance to QA on customer complaint problems. Provide analytical assistance to support quality improvement programs identified through consumer response.

Status and Plans

1. Potential Product Problems

   Status: Samples of product, identified by QA as a potential customer problem are being analytically examined along with a control to determine if subject material contains substances normally not present in the cigarette.

   Plans: Continue analytical examination as needed.

2. Taste/Odor/Stale

   Status: Programs directed at reducing T/O/S category complaints are being supported by analytical measurements on a returned product when indicated by the nature of the complaint and on the availability of suitable returned material to test.

   Cigarettes packaged using film from three vendors have been tested under environmental stress conditions to determine if product stability is related to a particular film supplier.

   Compare subjective response to product OV.

   Plans: Continue to work with the Operations team to address the T/O/S concerns.

   Complete the analysis of the film study results.

   Complete subjective/OV study.

Resources: Currently 1 person is required to support this program and to remain at this level for the rest of 1988. Resources from PED and Flavor Development are also required.

2021555916

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

MATERIALS EVALUATION

Objective: Examine materials proposed for use in all PM USA facilities and render judgement as to their acceptability for proposed use. Each material that is proposed for use in our Manufacturing facilities is submitted for analysis to the Materials Evaluation Committee. Based upon the outcome of the analysis and the intended use of the material, the material is judged to be acceptable for use (general), acceptable for the intended use only, not recommended for use, not recommended - use until a replacement is found, or acceptable for use in non-tobacco areas only.

Status and Plans

1. Materials are being analyzed as they are submitted and recommendations as to their acceptability are made - continuing.

2. Presentations detailing the Materials Evaluation Program are being made* - continue making presentations at any PM USA facility upon request.

3. An audit program has been initiated. This program will audit previously approved materials to insure that if our vendors change suppliers, materials are still acceptable for use. Analysis of these samples will begin when a suitable sample procurement is finalized - 4th quarter.

4. Materials that have received "not recommended, use until a replacement is found" rating are being reviewed to determine if alternate materials have been found or are being sought - continuing.

5. Assisting QA in the analysis and identification of foreign material submitted from our facilities and offering recommendations on disposition - continuing.

6. Tours are being made of all PM USA facilities to identify materials that have not been evaluated and improper use of materials - continuing.

Resources: Currently 2.0 persons and to remain at this level in 1989.

*Presentation made in the past quarter included the following:

1. Mr. C. Horner's Staff Meeting.
2. Mr. W. Moore's Staff Meeting.
3. Dr. J. Charles' Staff Meeting.
4. Four presentations to MRO Purchasing and Inventory Control.
5. Three presentations at Cabarrus covering all three shifts.
6. Staff Engineering at Stockton Street.

2021555917

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

NEW TOBACCO PROCESSES

Objective: To provide support on an as needed basis to various processing operations.

Status and Plans

1. Stem Processing

   Status: Evaluation of Dickinson Admoist unit to condition whole stems has been completed and equipment has been shipped to Bermuda 100.

   Evaluation of process parameters for optimization of rolled/cut stems is on-going.

   Plans: Continue support.

2. Oriental Pads

   Status: Testing of Dickinson Admoist unit to reduce pads has been completed and showed promise. However, based on results new equipment will be designed.

   Plans: Complete new equipment - 2nd quarter, 1989.

Resource - 2.0

2021555918

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SUPPORT THE CURRENT BUSINESS

Objective: Provide analytical support on an as needed basis to various PM USA programs.

Status and Plans

1. Marlboro Standardization - standard run #6 is planned for October 17, 1988. (2)

2. Provide CI type information on cigarettes as requested. (2)

3. Provide chemical and subjective analyses to support the tobacco storage container study for engineering. (1)

4. Provide support in areas of analytical methods, standards and measurement development. Flavor center has been supplied with a method for water, ethanol, propylene glycol and glycerin in casings and aftercuts. (3)

5. Provide analytical and subjective support to develop test methods for measuring packaging solvents and transmit to QA for monitoring. All new materials are first analyzed by R&D one time before QA picks up testing. Comparative audit of QA versus R&D on periodic basis - first audit conducted in September and was satisfactory. (3)

6. Investigate use of an InfraAlyzer for off-line analysis of triacetin in filter plugs. An off-line method has been developed and seems feasible. (1)

7. Viscosity and inkometer studies of printing inks show significant batch to batch variability. Color determination, printability and dryness testing are now being investigated. (1)

8. Adhesive Support (1)

   a. TGA investigations are on-going.

   b. An instron method to evaluate adhesive-paper bonds is just now being considered. A standard method of application to prepare samples is being pursued.

9. Investigate the use of relative humidity to develop a rapid procedure for moisture determination in the stemmeries. Testing is underway. (1)

2021555919

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

RECEIVED
NOV 22 1988
CLIFF LILLY

To: Dr. R. A. Fenner

Date: November 14, 1988

From: I. L. Uydess

Subject: Inclusion of Project 1730 in Operations Support Program

A request was recently made by Dr. Charles to evaluate the inclusion of Project 1730 (Cell & Tissue Culture Research) in the Operations Support Program. This occurred as a result of discussions with K. Houghton and R. Cox following an update of the status & plans of the Paraben Replacement Program. This memo addresses that request.

Project 1730 personnel are currently involved in investigations in support of Park 500 which address the need for identifying and evaluating prospective new preservatives as replacements for and/or as adjuncts to propylparaben (1). The rationale for this is two-fold. First, propylene glycol, the present carrier for propylparaben, may have to be replaced as a tobacco additive. In addition, Philip Morris is continually trying to improve the quality of it's products by making them as "natural" as possible by replacing synthetic ingredients with naturally-occurring ingredients. In pursuit of these goals, Project 1730 personnel have been screening a variety of "nature identical" biochemicals of botanical origin as potential replacements for (or adjuncts to) propylparaben.

Program Status:

Over the past year, several "broad-sweep" assays have been employed to evaluate the antimicrobial impact of a number of candidate compounds, including: Sucrose Esters, Essential Oils, and most recently, tobacco-identical Fatty Acids (2). Among the Fatty Acids (FAs) that were tested, several intermediate-length compounds (C-10 thru C-12) proved to be effective inhibitors of bacterial growth based upon the results of the initial screens that were conducted. As a result of these observations, C-Pilot Plant production trials were run in order to make sufficient RL sheet (+/- preservative) to allow subjective as well as toxicological evaluations to be conducted. At the same time, the compounds of interest (including alcohol derivatives of the fatty acids, and combinations of fatty acids and propylparaben) were also subjected to more rigorous testing in SEL so that additional information could be generated regarding how well these materials performed under more realistic (process-like) conditions.

2021555920

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Project Personnel:

Project 1730 is currently staffed by the following individuals:

I. L. Uydess (PL)	Associate Senior Scientist
D. M. Teng	Associate Senior Scientist
L. Weissbecker	Research Scientist
J. L. Lyle	Associate Scientist B
M. A. Shulleeta	Associate Scientist B
S. W. Tenhet	Associate Scientist A

Experimental protocols are written by the Project Leader in collaboration with the other members of the laboratory. Experiments are carried out either by individuals, or teams of individuals (as required) in each of the three major areas of investigation:

A) Phase I screens	-	Shulleeta & Tenhet
B) Microbiological Investigations (Phase II Screens) & Evaluation of Spoilage	-	Weissbecker & Lyle
C) Biochemical Investigations & Phase III (Fermentor) Screens	-	Teng, Shulleeta & Tenhet

Program Plans: 4th Quarter, 1988 - 1st Quarter, 1989

The following technical objectives have been set for the 4th quarter of 1988 and 1st quarter of 1989. Some modification of these objectives may occur as the data from each test become available and are evaluated.

1] Nov/Dec, 1988: Continue the evaluation of the medium-length (C-8 thru C-12) fatty acids and fatty alcohols in the Phase II SEL screen.

2] 4th Quarter, 1988: Examine the efficacy of employing mixtures of fatty acids or fatty alcohols and propylparaben in Phase I & II screens.

3] 4th Quarter 1988 and Continuing: Continue the development of Chemical & Microbiological criteria to define spoilage of SEL.

4] 4th Quarter, 1988: Establish a Phase III (fermentor-based) model system of Park 500 (Line 2).

5] 4th Quarter, 1988: Test prospective fatty acid/fatty alcohol preservatives in Phase III fermentor screens.

2021555921

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

6] 4th Quarter 1988 and Continuing: Evaluate other prospective candidate materials, including:

- Derivatives of C-10 thru C-12 fatty acids,
- Designer Di-Esters of short and intermediate chain length fatty acids,
- Components of Essential Oils,
- Phytoalexins (?)

7] Conduct additional C-Pilot Plant production runs for evaluation on an as-needed basis.

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1. Uydess, I. L. et.al. Development of Microbiological Screens for Identifying & Evaluating Tobacco-Identical Preservatives as Replacements for Propylparaben. PM Memo to Dr. E. B. Sanders; September 2, 1987.

2. Shulleeta, M. A. and S. W. Tenhet. Evaluation of C-5 thru C-14 Fatty Acids as Prospective Preservatives. PM Memo to Dr. Rett Southwick; July 6, 1988.

3. Uydess, I. L. Status & Plans of the Parabens Replacement Program. PM Memo to Dr. R. W. McCuen; July, 1988.

cc: J. L. Charles
C. K. Ellis
A. C. Lilly
R. W. McCuen
E. B. Sanders

2021555922

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

- Project 1730: Paraben Replacement Program -

(SUMMARY)

OBJECTIVE: To provide support to PM's manufacturing facilities (such as Park 500) with specific regard to the identification of alternative, nature-identical preservatives for use in tobacco.

STATUS: Several tobacco-identical fatty acids (C-10 thru C-12) have been found to be potent inhibitors of microbial growth in the Phase I preservative screens that have been conducted.

STRATEGIES: The appropriate microbiological screens will be employed in order to determine the antimicrobial impact of a number of targeted compounds currently under evaluation as prospective preservatives for use in SEL. Pilot Plant trials will be conducted to support subjective (and other) evaluations to assure the efficacy and appropriateness of the targeted compounds.

TACTICS & TIMETABLES: A C-Pilot Plant production run (+/- preservative) for the purpose of conducting subjective evaluations and further laboratory (Phase II, SEL) testing are scheduled for the 4th quarter of 1988 and the 1st quarter of 1989.

RESOURCE ALLOCATIONS: Project 1730 is staffed by 6 personnel which occupy facilities in D-Building (D-114) and the Research Tower (T-713).

2021555923

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: A. C. Lilly **Date:** November 15, 1988

From: C. S. Kroustalis

Subject: Operations Support - Fourth Quarter Planning Meeting

Attached, please find the fourth quarter update for Operations Support programs. Please let me know if additional information is required.

Attachments

C. S. Kroustalis

cc: J. Charles
W. Kuhn

2021555924

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SEMIWORKS SUPPORT

Objective: Use a small scale fabrication unit, the Semiworks, to provide cigarette production to evaluate new blends, new processes, new materials and other production related improvements to support PM USA programs.

Status and Plans

1. Support the Marlboro Standardization Program

   Status: Semiworks, as a production facility, participates in the program. Marlboro Standardization VI was completed.

   Plans: Marlboro Standardization VII will be scheduled during the first or second quarter of 1989.

2. Support Flavor Modification Programs

   Status: Support on-going programs.

   Plans: Continue support.

3. Support the Offshore Tobacco Reduction Program

   Status: Blends designed by the Leaf Department are being made.

   Plans: Continue support.

4. Support to Improve the Processing Plants

   Status: Hauni Steam Tunnel Investigation is underway.

   Plans: Continue programs.

5. Support the TLA Program

   Status: Cigarettes from individual leaf grades are being fabricated in the Semiworks.

   Plans: Continue this service.

Resource: 6 persons for 1988. Resources are also required from Analytical and Cigarette Testing.

2021555925

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO SHEET IMPROVEMENTS

Objective: Support efforts to improve the quality of PM USA sheet products by investigating alternate methods of production.

Status and Plans

1. Yankee Release Agents

   Status: Materials have been approved for use. Production from the RL Pilot Plant has been submitted for subjective screening by Flavor Development. PEG dioleate has been eliminated. Currently looking for a substitute.

   Plans: Final process and subjective testing at Park 500.

2. Humectant Rearrangement

   Status: Investigations with products made at the Semiworks are complete.

   Plans: Formal factory trials with proposed humectant composition to determine spotting incidence.

   Supply accountability calculations using OV residual basis methods.

3. Dry Flavor Replacement

   Status: Investigations to replace dry flavors with liquid flavors to improve flavor dispersion in RCB and reduce thickening and recycle of size in RL are in place.

   Plans: Implement plans when liquid flavor samples are received from vendors near the end of September. Flavor Development will compound the flavors and evaluate product including RCB.

4. Miscellaneous Projects

   Status: Pilot Plant and process development resources have been provided as needed.

   Plans: Continuing program.

Resources: Projected for 1.5 persons in 1988. Resources from Analytical Research, Cigarette Testing, Flavor Development, PED, Semiworks, and the Pilot Plant are also required.

2021555926

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

BURLEY SPRAY

Objective: Determine the level and uniformity of application of burley spray to strip by measuring selected chemical components of the burley spray to support efforts to standardize and/or improve burley spray application.

Status and Plans

Work in this area has been placed on hold because of other higher priority activities.

2021555927

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO MICROBIOLOGY

Objective: Provide support to various PM USA programs in the areas of microorganism populations and alternate processing techniques to reduce organism populations. Develop standard methodology which can be turned over to QA at the appropriate time.

Status and Plans

1. Alternate Humectant Program

   Status: Microbiological populations have been determined on all of the test materials from this program.

   Plans: Additional work is anticipated on selected feedstocks.

2. Leaf Department

   Status: Microbial counts have been made on the hogshead, box, bale storage study for the Leaf Department.

   Plans: Complete study as requested.

3. Miscellaneous

   Status: Bacterial identifications, as requested.

   Plans: Study effects of the removal of potassium sorbate from the RCB process. A proposal will be written.

   Future plans also will include ART filler, adsorber stems, and other service work.

Resources: Projected for 5 persons in 1988.

2021555928

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENTOMOLOGY SUPPORT

Objective: Provide entomology support in a timely manner to support PM USA and International efforts in tobacco beetle control and pesticide control. Serve as the experts within the Company to provide assistance in controlling the tobacco beetle and other pests at all locations.

Status and Plans

1. Pesticides

   Status: Support for on-going pest control programs is being provided through information, assistance, education and guidance in choice of pesticide, application rate, frequency, and other current pertinent considerations to appropriate personnel with PM USA and TTG.

   Plans: This is an on-going program and will continue at the current level. Update the acceptable pesticide list.

2. Kabat

   Status: Efforts to assure the uniform application of desired levels at the stemmeries are being supported.

   Plans: Determine Kabat dosage and time required for protection from beetle infestation of stems during storage. Continue to assure methodology compliance at contract laboratory. ARD plans to provide assistance with methoprene analysis during the second quarter of 1989.

3. Fumigation

   Status: Support for on-going program is being provided to appropriate personnel.

   Plans: This is an on-going program, support will continue at the current level.

   Obtain ARS/APHIS approval for phytosanitary certification of export cut filler using Ageless and Isolcel.

   Issue the final report on CO_2 as a fumigant.

4. Related Activities

   Continue to gather data on the distribution of the cigarette beetle as it relates to the processing of tobacco into cigarettes (the supply side of our operation prior to cigarette Making).

   Implement procedures for obtaining data on the distribution of cigarette beetle on the finished product side of our operations.

   Prepare a training video to address cigarette beetle control.

2021555929

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

Gather data to determine the efficiency of the pheromone trap.

Devise and test methods to remove the Tyvek bag from processed tobacco (expanded strip, expanded stems, and improved stems).

Resources: Projected 5.0 persons for 1988. Also requires resources from Analytical Research and Flavor Development.

2021555930

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENVIRONMENTAL TOBACCO SMOKE

Objective: To provide PM USA and International Corporate Affairs and Science and Technology with information and technical support to combat proposed legislation to restrict smoking.

Status and Plans

1. CO Measurement

   Status: For an alternative to using electrochemical detectors, a non-dispersive IR is being configured in a portable case.

   Plans: Electrochemical cell and solid state sensors are still being evaluated.

2. Aircraft Studies

   Status: Providing technical assistance for SAS study being conducted by TNO Laboratories.

   Plans: As needed.

3. R&D Field Studies

   Status: Cafeteria study completed.

   Plans: No additional cafeterias to be studied. Plan protocols for Amtrak.

Resources: 6

2021555931

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ANALYTICAL FLAVOR SPECIFICATIONS

Objectives: To develop chemical and physical specifications for current, incoming flavor materials and to transmit specifications and methods for monitoring specifications to appropriate groups by the end of 1989.

Status and Plans

1. Vendor Agreements - continuing.

2. Specifications

   Status: One vendor completed, second vendor essentially completed.

   Plans: Continue.

3. German Flavors

   Status: Specifications for flavor materials used in German flavors have been completed and transferred to appropriate groups. Certification of a high volume finished flavor will be completed by mid-November.

   Plans: Continue certifications of finished German, Swiss, and Netherlands flavors using specific markers for forbidden substances for approximately one year. QA will take over certifications after methodology is transferred to them.

4. Specifications and Methods Transfer

   Status: Specifications are being entered into the QA computer. All incoming material profile (IMP) methods developed have been transferred.

   Plans: Continue to transmit specifications as they are developed. Provide assistance for implementation.

Resources: 4

2021555932

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CUSTOMER COMPLAINTS

Objective: Provide analytical assistance to QA on customer complaint problems. Provide analytical assistance to support quality improvement programs identified through consumer response.

Status and Plans

1. Potential Product Problems

   Status: Samples of product, identified by QA as a potential customer problem are being analytically examined along with a control to determine if subject material contains substances normally not present in the cigarette.

   Plans: Continue analytical examination as needed.

2. Taste/Odor/Stale

   Status: Programs directed at reducing T/O/S category complaints are being supported by analytical measurements on a returned product when indicated by the nature of the complaint and on the availability of suitable returned material to test.

   Cigarettes packaged using film from three vendors have been tested under environmental stress conditions to determine if product stability is related to a particular film supplier. Normal OV determinations showed no differences.

   Comparison of subjective response to product OV showed the following relationships: 1) strength increased with OV increase and 2) acceptability decreased with increasing OV.

   Plans: Continue to work with the Operations team to address the T/O/S concerns.

   A report on the film study results will be written by R. Dunaway.

Resources: Currently 1 person is required to support this program and to remain at this level for the rest of 1988. Resources from PED and Flavor Development are also required.

2021555933

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

MATERIALS EVALUATION

Objective: Examine materials proposed for use in all PM USA facilities and render judgement as to their acceptability for proposed use. Each material that is proposed for use in our Manufacturing facilities is submitted for analysis to the Materials Evaluation Committee. Based upon the outcome of the analysis and the intended use of the material, the material is judged to be acceptable for use (general), acceptable for the intended use only, not recommended for use, not recommended - use until a replacement is found, or acceptable for use in non-tobacco areas only.

Status and Plans

1. Materials are being analyzed as they are submitted and recommendations as to their acceptability ar[Bmade - continuing.

2. Presentations detailing the Materials Evaluation Program are being made* - continue making presentations at any PM USA facility upon request.

3. An audit program has been initiated. This program will audit previously approved materials to insure that if our vendors change suppliers, materials are still acceptable for use. Analysis of these samples will begin when a suitable sample procurement is finalized - 4th quarter. Chris Irving's project will incur audit program expenses.

4. Materials that have received "not recommended, use until a replacement is found" rating are being reviewed to determine if alternate materials have been found or are being sought - continuing.

5. Assisting QA in the analysis and identification of foreign material submitted from our facilities and offering recommendations on disposition - continuing.

6. Tours are being made of all PM USA facilities to identify materials that have not been evaluated and improper use of materials - continuing.

Resources: Currently 2.0 persons and to remain at this level in 1989.

*Presentation made in the past quarter included the following:

1. Mr. C. Horner's Staff Meeting.
2. Mr. W. Moore's Staff Meeting.
3. Dr. J. Charles' Staff Meeting.
4. Four presentations to MRO Purchasing and Inventory Control.
5. Three presentations at Cabarrus covering all three shifts.
6. Staff Engineering at Stockton Street.

2021555934

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

NEW TOBACCO PROCESSES

Objective: To provide support on an as needed basis to various processing operations.

Status and Plans

1. Stem Processing

   Status: Evaluation of Dickinson Admoist unit to condition whole stems has been completed and equipment has been shipped to Bermuda 100.

   Evaluation of process parameters for optimization of rolled/cut stems is on-going.

   Plans: Continue support.

2. Oriental Pads

   Status: Testing of Dickinson Admoist unit to reduce pads has been completed and showed promise. However, based on results new equipment will be designed.

   Plans: Complete new equipment - 2nd quarter, 1989.

Resource - 2.0

2021555935

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SUPPORT THE CURRENT BUSINESS

Objective: Provide analytical support on an as needed basis to various PM USA programs.

Status and Plans

1. Marlboro Standardization - standard run #6 was completed on October 17, 1988. An additional run is tentatively planned for the first quarter of 1989. (2)

2. Provide CI type information on cigarettes as requested. (2)

3. Provide chemical and subjective analyses to support the tobacco storage container study for engineering. (1)

4. Provide support in areas of analytical methods, standards and measurement development. All QA facilities have been supplied with a method for water, ethanol, propylene glycol and glycerin in casings and aftercuts. Implementation will take place after the evaluation of purchased GC columns. (3)

5. Provide analytical and subjective support to develop test methods for measuring packaging solvents and transmit to QA for monitoring. All new materials are first analyzed by R&D one time before QA picks up testing. Comparative audit of QA versus R&D on periodic basis - first audit conducted in September and was satisfactory. (3)

6. Investigate use of an InfraAlyzer for off-line analysis of triacetin in filter plugs. An off-line method has been developed and seems feasible by controlling RH. (1)

7. Viscosity and inkometer studies of printing inks show significant batch to batch variability. Color determination, printability and dryness testing are now being investigated. (1)

8. Adhesive Support (1)

   a. TGA investigations are on-going.

   b. An instron method to evaluate adhesive-paper bonds is just now being considered. A standard method of application to prepare samples is being pursued.

9. Investigate the use of relative humidity to develop a rapid procedure for moisture determination in the stemmeries. Testing is underway. (1)

2021555936

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CONFIDENTIAL

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

RICHMOND, VIRGINIA

RECEIVED

JUL 19 1988

CLIFF LILLY

To: A. C. Lilly

Date: July 18, 1988

From: R. H. Cox

Subject: Update of Operations Support Following 2nd Quarter Planning Meeting

Attached, please find an update of the Operations Support Plans for the remainder of 1988. The changes in the plans are minor for most programs. However, please note that there is a new program for New Tobacco Processes from H. Alonso.

Please advise if further information is required.

R. H. Cox

Attachments

cc: J. Charles
B. Handy
W. Kuhn

2021555937

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

MATERIALS EVALUATIONS

Objective: Examine materials proposed for use in PM USA and render judgement as to their suitability for proposed use.

Status: Each material that is proposed for use in our manufacturing facilities is submitted for analysis to the Materials Evaluation Group. Based upon the outcome of the analysis and the intended use of the material, the material is judged to be suitable for use, not suitable for intended use or use until a substitute is found.

Strategies: Continue to examine materials as they are submitted and provide a decision within a reasonable time period.

Tactics & Timetable

1. Analyze materials as they are submitted and render judgement as to suitability for intended use - continuing.

2. Implement plan to audit previously approved materials. This is to insure that materials are still suitable for use, e.g., vendors may have changed suppliers. Selection protocol has been established, testing will begin in July.

3. Audit materials that have received a "use until substitute is found" rating to insure that alternate materials are being sought - program initiated - continuing.

4. Formulate written guidelines for response to foreign matter occurrence - 1989.

Resources: 2.5 persons and this level of support is needed to meet objectives in 2 and 3.

2021555938

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CUSTOMER COMPLAINTS

Objective: Provide analytical assistance to QA on customer complaint samples that have the potential for future litigation on an as needed basis. Provide assistance to efforts to reduce Taste/Odor/Stale complaints.

Status: All customer complaint samples returned to QA that have the potential for future liability are submitted to ARD for analytical examination and findings are reported back to QA.

Strategies: Use appropriate analytical methods to examine all materials submitted and compare with an appropriate control to determine if subject cigarettes are different from a normal cigarette. Perform appropriate analytical tests as indicated by Taste/Odor/Stale complaints.

Tactics and Timetable:

1. Analytically examine each material submitted along with a control and determine if subject material contains substances not normally present in cigarettes - continuing on an as-needed basis.

2. Work with vendors to develop a water based ink system for PM use. Testing underway.

3. Test subjective response as a function of cigarette OV on selected brands.

Resources: Currently 1 person and to remain at this level in 1988.

2021555939

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ANALYTICAL FLAVOR SPECIFICATIONS

Objectives: To develop chemical and physical specifications for current, incoming flavor materials and to transmit specifications and methods for monitoring specifications to appropriate groups by the end of 1989.

Status: For business reasons and as a result of regulatory pressures, it is imperative that we know specifically what components are present in our incoming flavor materials to assure compliance with regulatory agencies and to assure compliance with our specifications. Specifications and analytical methods for the approximately 95 flavors for the German flavor formulations have been developed and are in the process of final approval.

Strategy: During 1987, a group was established within ARD to examine all incoming flavor materials and establish specifications for these materials based upon the results of the physical and chemical tests developed. The specifications and methods for monitoring will be transmitted to appropriate groups as they are developed.

Tactics and Timetable

1. Obtain agreements with vendors as to materials present in compounded flavors - complete.

2. Develop specifications and methods for monitoring incoming flavor materials - complete by 4th quarter, 1989.

3. Provide assistance to the Flavor Center Lab as necessary for implementation of the specifications and methods.

4. Transmit specifications and methods for monitoring to appropriate groups as they are developed. Continue to provide assistance as necessary.

5. Develop specifications and methods for incoming bulk liquids for QA implementations at the various manufacturing and process facilities.

Resources: Currently, this group has 8 persons assigned, 7 are from R&D. It is expected that this level of support will be required as least until the end of 1989.

2021555940

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENVIRONMENTAL TOBACCO SMOKE

Objective: To provide PM USA and International Corporate Affairs and Science and Technology with information to aid their efforts to combat proposed legislation to restrict smoking.

Status: With the ever increasing emphasis on banning smoking in public places, in the workplace and on public transportation systems, it is essential that we obtain data on the contribution of environmental tobacco smoke to air quality. The modified power supply, modified nicotine sampling system and modified electronics for use of AC adapter of the PASS samplers are complete. Training of field sampling personnel is complete.

Strategy: Utilize the PASS (Portable Air Sampling System) samplers to obtain data on nicotine, carbon monoxide and particulate levels in air samples.

Tactics & Timetables

1. Modifications to existing Neotronics CO sensor have not fully resolved problems encountered in aircraft environment (pressure, humidity). Three new prototypes have been received and are now being installed in PASS units for testing.

2. Permission has been obtained for testing on SAS (Scandanavian Airlines) which has its hub in Copenhagen. Discussions are underway to define protocols and resource requirements from Europe (TNO laboratory, Delf Holland) and USA (PM and RJR). The goal is to have TNO perform this testing.

3. Documentation of results from December 1987 studies is complete. Manuscripts have been submitted for publication. The Hong Kong restaurant results have as well been released in news conferences in Hong Kong (By G. Oldaker, RJR).

4. Cafeteria studies on site have been planned and a study of the R&D cafeteria has been completed. Under public transportation studies, planning for a study on AMTRAK is in the preliminary stage. AMTRAK routes from Richmond with a same day turnaround have been identified.

Resources: 6.0 persons will be required for 1988.

2021555941

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENTOMOLOGY SUPPORT

Objective: Provide entomology support in a timely manner to support PM USA and International efforts in tobacco beetle control and pesticide control.

Status: As the resident experts within the Company, this group is called upon to provide assistance in controlling the tobacco beetle problem in all locations and in controlling other pests.

Strategies: Continue to provide support as requested and investigate alternate methods for controlling pests.

Tactics & Timetable

1. Provide information on pest control such as choice of pesticide, application rate, frequency, safety considerations, etc. to appropriate personnel within PM USA - continuing.

2. Provide information and assistance to appropriate personnel within PM USA regarding fumigations - continuing.

3. Provide information and assistance to appropriate personnel within PM International regarding pest control - continuing.

4. Conduct experiments in area of efficacy testing to determine alternate methods for pest control - continuing.

5. Obtain ARS approval for use of the ISOCELL chamber for fumigation of tobacco - 3rd quarter.

6. Complete efficacy testing of Ageless - 4th quarter.

Resources: On the average, 5.0 persons projected for 1988. Also requires some resources from Analytical, Flavor Development and the Leaf Department.

2021555942

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO MICROBIOLOGY

Objective: Provide support in a timely manner to various PM USA programs in areas of microorganisms. This information is frequently combined with analytical and subjective data to form a more complete picture. Develop standard Methodology which can be turned over to QA at the appropriate time.

Status: Support is requested to support various programs in the area of microorganism populations and alternate processing techniques to reduce organism populations.

Strategies: Use appropriate microbiological techniques to determine organism population and aid in investigations to reduce populations.

Tactics & Timetable: Provide microbiology data to support various programs such as The Alternate Humectant Program, Tobacco Storage Container Study, Project Delta, Project ART, Burley Spray and other programs as requested - continuing.

Resources: Projected for 5 persons in 1988.

2021555943

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO SHEET IMPROVEMENTS

Objective: Investigate alternate methods in sheet production area to improve sheet products and their utilization in the cigarette factories.

Status: Continued technical support is required to maintain plant ability to produce lowest cost/highest quality products to improve market share.

Strategies: Implement laboratory and pilot plant programs, and provide on-site factory technical support, as required to improve the quality and consistency of our products, optimize sheet material utilization, modify sheet materials to meet new product needs, and conform to changing regulatory and business requirements.

Tactics & Timetable

1. Support Operations Services in the evaluation and implementation of an improved factory accountability system utilizing an OV residual basis mass balance - continuing.

2. Evaluate blend humectant rearrangement as a means to more evenly distribute humectant loading, improve blend formulation flexibility, and reduce sheet types in inventory - December, 1988.

3. Conduct subjective and survivability testing as required to qualify process modifications proposed for incorporation with the fourth RL Plant production line. - September, 1988.

4. Develop replacement flavors for sheet material dry flavors to improve flavor distribution and reduce subjective variability, operational problems and effluence loading - December, 1988.

5. Provide technical support for Park 500 as required relating to Yankee dryer release agents, oriental sheet production, pad reduction, OTM utilization, and planned new equipment (Wiegand evaporators, refined stock screens, size screens). Serve as a technical resource in the areas of new paper industry technology, competitor reconstituted tobacco activity and preservative systems - continuing.

Resources: Projected allocation of Tobacco Materials personnel is 2.0 for the remainder of 1988 (1.0 professional; 1.0 technician). Also requires resources from Analytical Research, Flavor Development, Semiworks, PED, Microbiology, Cigarette Testing (plus Operations Services and Stockton Street).

2021555944

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SEMIWORKS SUPPORT

Objective: Provide cigarette fabrication in a timely manner to support PM USA programs.

Status: As a small scale fabrication unit, the Semiworks is requested to provide cigarette production to evaluate new blends, new processes, new materials, etc.

Strategies: Provide cigarette fabrication on an as-needed basis for analytical and subjective testing.

Tactics & Timetables

1. Support the Marlboro Standardization Program - as needed.
2. Support flavor modifications - as needed.
3. Support the Offshore Tobacco Reduction Program - as needed.
4. Support efforts to improve the processing plants - as needed.
5. Support the TLA program - continuing.
6. Provide cigarettes to support marketing efforts - as needed.

Resources: For this effort, 6 persons are projected for 1988. Resources are also required from Analytical and Cigarette Testing.

2021555945

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

BURLEY SPRAY PROGRAM

Objective: Determine the level and uniformity of application of burley spray to strip and the effect of process variables on the chemical composition and subjective characteristics of the product. Measure selected chemical components of the burley spray to support efforts toward factory standardization and material accountabilities.

Status: Two "hard drying" and one "normal" run have been sampled at the M/C to determine nicotine, PG, and GLY losses. Hard drying shows nicotine losses of 10%, PG 30% and GLY 7%.

Strategies: Work with M/C Production and Operations Services personnel to collect additional data points to support and confirm losses and uniformity of components in the burley spray system.

Tactics & Timetables

1. Establish mass balance of nicotine, PG and GLY as a function of "hard drying and normal drying" - 3rd quarter, 1988.

2. Determine the uniformity of the burley spray application using sugars and PG as the spray component tracer - 4th quarter, 1988.

3. Determine the chemical and subjective effects of changes in OV of burley going into the cooling zone of the Proctor Schwartz dryer. Current standards set normal operation target OV at this location at 16% ± 2% (14% - 18% window). Normal operation will provide material at the high and low range limits for testing - 4th quarter, 1988.

4. Plan and investigate laboratory scale experiments to test the burley spray/burley tobacco reaction and volatile loss hypotheses - 4th quarter, 1988.

Resources: 2.0

2021555946

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SUPPORT THE CURRENT BUSINESS

Objective: Provide analytical support on an as-needed basis to various PM USA programs.

Status: There are a number of on-going programs which require analytical support from time to time. In addition, special questions arise which can usually be answered in a short time.

Strategies: Support the current business in a timely manner.

Tactics & Timetables

A partial listing of programs in this area is given below. The number of resources required is given in parenthesis.

1. Marlboro Standardization - Several factory pickups for analyticals and subjectives are anticipated for 1988. (2)

2. Provide CI type information on cigarettes as requested. Investigate differences between CI and TITL laboratories. (2)

3. Provide chemical and subjective analyses to support the tobacco storage container study for engineering. (1)

4. Provide support in areas of analytical methods, standards and measurement development. (3)

5. Provide analytical and subjective support to develop test methods for measuring packaging solvents and transmit to QA for monitoring. (3)

6. Investigate the use of an InfraAlyzer for either on or off-line analysis of triacetin in filter plugs. (1)

7. Conduct viscosity and inkometer studies of printing inks used in factory locations. (1)

8. Conduct simulator studies and TGA analyses of tipping adhesives, develop Instron procedure for characterizing adhesive-paper bonds. (1)

9. Investigate the use of relative humidity to develop a rapid procedure for moisture determination in the stemmeries. (1)

2021555947

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

NEW TOBACCO PROCESSES

KABAT APPLICATION

Objective: Support efforts to expand the utilization of KABAT on PM tobacco materials.

Status: Currently, PM is applying KABAT onto strip at double the rate of our competitors. Also, application of KABAT onto other tobaccos, such as Oriental, stems, and scrap may be beneficial to PM.

Strategy: Determine whether KABAT can be uniformly sprayed onto Stemmery scrap at desired levels (2.5-5.0 ppm).

Tactics & Timetable: During the third quarter of 1988, a casing system in D Pilot Plant will be used to determine the feasibility of applying KABAT to Stemmery scrap.

Resources: Professional = 0.2, Technician = 0.6

STEM PROCESSING

Objective: Optimize processing parameters for the production of rolled/cut stem products.

Status: The Louisville Stem Processing Facility is producing both IS and ES, which are rolled/cut stem products. Continued technical support is required to produce these materials as lowest cost/highest quality products.

Strategy: Utilize the rolled/cut stem line in D Pilot Plant to optimize processing parameters for production of stem products.

Tactics & Timetable:

1. During the third quarter of 1988, complete the evaluation of the Dickinson Admoist unit as a conditioner of whole stems.

2. Continue the optimization of rolled/cut stem processing during the second half of 1988. This includes evaluation of processing times, moistures, temperatures, rolling thickness, and throughput.

Resources: Professional = 0.4, Technician = 1.0.

2021555948

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ORIENTAL PAD REDUCTION

Objective: Support efforts to reduce Oriental pads at the Leaf Processing Facility.

Status: The occurrence of pads during Oriental processing, and current methods of pad reduction, cause process yield losses and product size reductions.

Strategy: In coordination with Process Engineering, determine an improved method of Oriental pad reduction.

Tactics & Timetable: During the third quarter of 1988, complete testing to determine the feasibility of using the Dickinson Admoist unit to significantly reduce Oriental pads.

Resource: Professional = 0.1, Technician = 0.4

2021555949

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

RECEIVED
JUN 0 6 1988
CLIFF LILLY

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

RICHMOND, VIRGINIA

To: A. C. Lilly

Date: June 6, 1988

From: R. H. Cox

CONFIDENTIAL

Subject: Operations Support Plans for 1988

Attached, please find the plans for the Operations Support Program for 1988. As written, we are projecting a total of 50 persons from R&D being devoted to this program. Please inform me if further information is required.

Attachments

R. H. Cox

cc: J. Charles
W. Kuhn

2021555950

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

MATERIALS EVALUATIONS

Objective: Examine materials proposed for use in PM USA and render judgement as to their suitability for proposed use.

Status: Each material that is proposed for use in our manufacturing facilities is submitted for analysis to the Materials Evaluation Group. Based upon the outcome of the analysis and the intended use of the material, the material is judged to be suitable for use, not suitable for intended use or use until a substitute is found.

Strategies: Continue to examine materials as they are submitted and provide a decision within a reasonable time period.

Tactics & Timetable

1. Analyze materials as they are submitted and render judgement as to suitability for intended use - continuing.

2. Institute plan to audit previously approved materials to insure that if our vendors have changed suppliers, materials are still suitable for use - plans in place and program initiated by 2nd quarter.

3. Audit materials that have received a "use until substitute is found" rating to insure that alternate materials are being sought - plans in place and program initiated during 2nd quarter.

Resource Allocation: Currently 1.5 persons and to remain at this level in 1988.

2021555951

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CUSTOMER COMPLAINTS

Objective: Provide analytical assistance to QA on customer complaint samples that have the potential for future litigation on an as needed basis.

Status: All customer complaint samples returned to QA that have the potential for future liability are submitted to ARD for analytical examination and findings are reported back to QA.

Strategies: Use appropriate analytical methods to examine all materials submitted and compare with an appropriate control to determine if subject cigarettes are different from a normal cigarette.

Tactics and Timetable:

1. Analytically examine each material submitted along with a control and determine if subject material contains substances not normally present in cigarettes - continuing on an as needed basis.

2. Work with vendors to develop a water based ink system for PM use.

Resources: Currently 1 person and to remain at this level in 1988.

2021555952

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ANALYTICAL FLAVOR SPECIFICATIONS

Objectives: To develop chemical and physical specifications for current, incoming flavor materials and to transmit specifications and methods for monitoring specifications to appropriate groups by the end of 1989.

Status: For business reasons and as a result of regulatory pressures, it is imperative that we know specifically what components are present in our incoming flavor materials to assure compliance with regulatory agencies and to assure compliance to our specifications.

Strategy: During 1987, a group was established within ARD to examine all incoming flavor materials and establish specifications for these materials based upon the results of the physical and chemical tests developed. The specifications and methods for monitoring will be transmitted to appropriate groups as they are developed.

Tactics and Timetable

1. Obtain agreements with vendors as to materials present in compounded flavors - continuing.

2. Develop specifications and methods for monitoring incoming flavor materials - continuing.

3. Complete specifications for flavor materials used in German flavors - 1st quarter 1988.

4. Transmit specifications and methods for monitoring to appropriate groups - Eight specifications transferred to QA Flavor Center during 4th quarter 1987 for trial run. Monitor progress of trial run and provide assistance as necessary. Continue to transmit specifications as they are developed. Provide assistance for implementation of specifications.

Resources: Currently, this group has 6 persons assigned, 5 of which are from R&D. It is anticipated that this level of support will be required as least until the end of 1989.

2021555953

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENVIRONMENTAL TOBACCO SMOKE

Objective: To provide PM USA and International Corporate Affairs and Science and Technology with information to aid their efforts to combat proposed legislation to restrict smoking.

Status: With the ever increasing emphasis to ban smoking in public places, in the workplace and on public transportation systems, it is essential that we obtain data on the contribution of environmental tobacco smoke to air quality.

Strategy: Utilize the PASS (Portable Air Sampling System) samplers to obtain data on nicotine, carbon monoxide and particulate levels in air samples.

Tactics & Timetables

1. Modify PASS unit to insure operation at reduced pressures encountered in airplanes - end of 1st quarter.

2. Assist in sampling of long distance airline flights and provide analytical measurements of collected samples. Tentative plans indicate a possibility of two or three long distance airline flight studies during 1988- as requested.

3. Provide assistance in analyzing and disseminating information obtained from studies conducted in December 1987 - 1st quarter.

4. Develop plans for further studies of PM cafeterias and public transportation systems (Amtrak) and obtain support to initiate plans - by the end of the 2nd quarter.

Resources: To complete the above will require 6 persons in 1988. Because this was not a "planned activity", other programs in ARD and Operations Support will be impacted if the above studies are conducted in 1988 without the addition of personnel to this program.

2021555954

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENTOMOLOGY SUPPORT

Objective: Provide entomology support in a timely manner to support PM USA and International efforts in tobacco beetle control and pesticide control.

Status: As the resident experts within the Company, this group is called upon to provide assistance in controlling the tobacco beetle problem in all locations and in controlling other pests.

Strategies: Continue to provide support as requested and investigate alternate methods for controlling pests.

Tactics & Timetable

1. Provide information on pest control such as choice of pesticide, application rate, frequency, safety considerations, etc. to appropriate personnel within PM USA - continuing.

2. Provide information and assistance to appropriate personnel within PM USA regarding fumigations - continuing.

3. Provide information and assistance to appropriate personnel within PM International regarding pest control - continuing.

4. Conduct experiments in area of efficacy testing to determine alternate methods for pest control - continuing.

Resource Allocation: On the average, 5.0 persons projected for 1988. Also requires some resources from Analytical, Flavor Development and the Leaf Department.

2021555955

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO MICROBIOLOGY

Objective: Provide support in a timely manner to various PM USA programs in areas of microorganisms. This information is frequently combined with analytical and subjective data to form a more complete picture. Develop standard Methodology which can be turned over to QA at the appropriate time.

Status: Support is requested to support various programs in the area of microorganism populations and alternate processing techniques to reduce organism populations.

Strategies: Use appropriate microbiological techniques to determine organism population and aid in investigations to reduce populations.

Tactics & Timetable: Provide microbiology data to support various programs such as The Alternate Humectant Program, Tobacco Storage Container Study, Project Delta, Project ART, Burley Spray and other programs as requested - continuing.

Resource Allocation: Projected for 5 persons in 1988.

2021555956

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO SHEET IMPROVEMENTS

Objective: Investigate alternate methods in sheet production area to improve sheet products.

Status: Support efforts to improve quality of PM USA sheet products by investigating alternate methods of production.

Strategies: Utilize the Pilot Plant to investigate alternate methods of sheet production and process improvements.

Tactics & Timetable

1. Evaluate alternate Yankee Dryer release agents to improve baseweb release from the dryer surface - continuing.

2. Support efforts to reduce humectants in sheet material - continuing.

3. Investigate replacement of dry flavors with liquid flavors to improve flavor dispersion in RCB and reduce thickening and recycle of size in RL - continuing. Provide Pilot Plant and process development for miscellaneous projects - as requested.

Resource Allocation: Projected for 2.5 persons in 1988. Also requires resources from Analytical, Cigarette Testing, Flavor Development, PED, Pilot Plant and Semiworks.

2021555957

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SEMIWORKS SUPPORT

Objective: Provide cigarette fabrication in a timely manner to support PM USA programs.

Status: As a small scale fabrication unit, the Semiworks is requested to provide cigarette production to evaluate new blends, new processes, new materials, etc.

Strategies: Provide cigarette fabrication on an as needed basis for analytical and subjective testing.

Tactics & Timetables

1. Support the Marlboro Standardization Program - as needed.
2. Support flavor modifications - as needed.
3. Support the Offshore Tobacco Reduction Program - as needed.
4. Support efforts to improve the processing plants - as needed.
5. Support the TLA program - continuing.
6. Provide cigarettes to support marketing efforts - as needed.

Resource Allocation: For this effort, 6 persons are projected for 1988. Resources are also required from Analytical and Cigarette Testing.

2021555958

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

BURLEY SPRAY PROGRAM

Objective: Determine the level and uniformity of application of burley spray to strip by measuring selected chemical components of the burley spray to support efforts to standardize and/or improve burley spray application.

Status: There is a current effort to evaluate alternate drying of burley strip and to standardize the application of burley spray in all Primaries.

Strategies: Provide analytical data to support the above efforts.

Tactics & Timetables

1. Provide chemical analyses of strip produced under a variety of drying conditions - as needed.

2. Provide chemical analyses of volatiles lost from the dryer as a function of dryer conditions - as needed.

3. Analyze components of burley spray to determine their possible use as predictors of application - continuing.

4. Investigate microscopy and image analysis as tools to determine the uniformity of burley spray application - 3rd quarter.

Resource Allocation: It is anticipated that 3 persons will be devoted to this activity in 1988.

2021555959

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SUPPORT THE CURRENT BUSINESS

Objective: Provide analytical support on an as needed basis to various PM USA programs.

Status: There are a number of on-going programs which require analytical support from time to time. In addition, special questions arise which can usually be answered in a short time.

Strategies: Support the current business in a timely manner.

Tactics & Timetables

A partial listing of programs in this area is given below. The number of resources required is given in parenthesis.

1. Marlboro Standardization - standard run #6 is planned for September, 1988. In addition 4-6 factory pickups for analyticals and subjectives are anticipated for 1988. (2)

2. Provide CI type information on cigarettes as requested. (2)

3. Provide chemical and subjective analyses to support the tobacco storage container study for engineering. (1)

4. Provide support in areas of analytical methods, standards and measurement development. (3)

5. Provide analytical and subjective support to develop test methods for measuring packaging solvents and transmit to QA for monitoring. (3)

6. Investigate the use of an Infralyzer for either on or off-line analysis of triacetin in filter plugs. (1)

7. Conduct viscosity and inkometer studies of printing inks used in factory locations. (1)

8. Conduct simulator studies and TGA analyses of tipping adhesives, develop instron procedure for characterizing adhesive-paper bonds. (1)

9. Investigate the use of relative humidity to develop a rapid procedure for moisture determination in the stemmeries. (1)

2021555960

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

PHILIP MORRIS U. S. A.

INTER-OFFICE CORRESPONDENCE

Richmond, Virginia

To: .J. L. Charles **Date:** January 25, 1988

From: .R. H. Cox

Subject: .Operations Support Plans for 1988

Attached, please find a first draft of Operations Support Plans for 1988. Your comments and suggestions would be appreciated. As written, I estimate that we will have an average of about 45.5 persons devoted to these programs in 1988.

Attachment

R H Cox

cc: W. F. Kuhn

2021555961

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

MATERIALS EVALUATIONS

Objective: Examine materials proposed for use in PM USA and render judgement as to their suitability for proposed use.

Status: Each material that is proposed for use in our manufacturing facilities is submitted for analysis to the Materials Evaluation Group. Based upon the outcome of the analysis and the intended use of the material, the material is judged to be suitable for use, not suitable for intended use or use until a substitute is found.

Strategies: Continue to examine materials as they are submitted and provide a decision within a reasonable time period.

Tactics & Timetable

1. Analyze materials as they are submitted and render judgement as to suitability for intended use - continuing.

2. Institute plan to audit previously approved materials to insure that if our vendors have changed suppliers, materials are still suitable for use - plans in place and program initiated by 2nd quarter.

3. Audit materials that have received a "use until substitute is found" rating to insure that alternate materials are being sought - plans in place and program initiated during 2nd quarter.

Resource Allocation: Currently 1.5 persons. During 1988, this should increase to 2.5 persons to eliminate backlog of samples due to increased submissions during the past two years.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

CUSTOMER COMPLAINTS

Objective: Provide analytical assistance to QA on customer complaint samples that have the potential for future litigation on an as needed basis.

Status: All customer complaint samples returned to QA that have the potential for future liability are submitted to ARD for analytical examination and findings are reported back to QA.

Strategies: Use appropriate analytical methods to examine all materials submitted and compare with an appropriate control to determine if subject cigarettes are different from a normal cigarette.

Tactics and Timetable: Analytically examine each material submitted along with a control and determine if subject material contains substances not normally present in cigarettes - continuing on an as needed basis.

Resources: Currently 1 person and to remain at this level in 1988.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ANALYTICAL FLAVOR SPECIFICATIONS

Objectives: To develop chemical and physical specifications for current, incoming flavor materials and to transmit specifications and methods for monitoring specifications to appropriate groups by the end of 1989.

Status: For business reasons and as a result of regulatory pressures, it is imperative that we know specifically what components are present in our incoming flavor materials to assure compliance with regulatory agencies and to assure compliance to our specifications.

Strategy: During 1987, a group was established within ARD to examine all incoming flavor materials and establish specifications for these materials based upon the results of the physical and chemical tests developed. The specifications and methods for monitoring will be transmitted to appropriate groups as they are developed.

Tactics and Timetable

1. Establish analytical group - March, 1987.
2. Occupy laboratory and initiate work - April, 1987.
3. Obtain agreements with vendors as to materials present in compounded flavors - continuing.
4. Develop specifications and methods for monitoring incoming flavor materials - continuing.
5. Complete specifications for flavor materials used in German flavors - 1st quarter 1988.
6. Transmit specifications and methods for monitoring to appropriate groups - Eight specifications transferred to QA Flavor Center during 4th quarter 1987 for trial run. Monitor progress of trial run and provide assistance as necessary. Continue to transmit specifications as they are developed.

Resources: Currently, this group has 5 persons from R&D. It is anticipated that this level of support will be required as least until the end of 1988.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENVIRONMENTAL TOBACCO SMOKE

Objective: To provide PM USA and International Corporate Affairs and Science and Technology with information to aid their efforts to combat proposed legislation to restrict smoking.

Status: With the ever increasing emphasis to ban smoking in public places, in the workplace and on public transportation systems, it is essential that we obtain data on the contribution of environmental tobacco smoke to air quality.

Strategy: Utilize the PASS samplers to obtain data on nicotine, carbon monoxide and particulate levels in air samples.

Tactics & Timetables

1. Complete study of air quality on New York City commuter train lines - end of 2nd quarter.

2. Modify PASS unit to insure operation at reduced pressures encountered in airplanes - end of 1st quarter.

3. Assist in sampling of long distance airline flights and provide analytical measurements of collected samples. Tentative plans indicate a possibility of two or three long distance airline flight studies during 1988- as requested.

4. Provide assistance in analyzing and disseminating information obtained from studies conducted in December 1987 - 1st quarter.

5. Develop plans for further studies of public transportation systems and obtain support to initiate plans - by the end of the 2nd quarter.

Resources: To complete the above will require 6 persons in 1988. Because this was not a "planned activity", other programs in ARD and Operations Support will be impacted if the above studies are conducted in 1988 without the addition of personnel to this program.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

ENTOMOLOGY SUPPORT

Objective: Provide entomology support in a timely manner to support PM USA and International efforts in tobacco beetle control and pesticide control.

Status: As the resident experts within the Company, this group is called upon to provide assistance in controlling the tobacco beetle problem in all locations and in controlling other pests.

Strategies: Continue to provide support as requested and investigate alternate methods for controlling pests.

Tactics & Timetable

1. Provide information on pest control such as choice of pesticide, application rate, frequency, safety considerations, etc. to appropriate personnel within PM USA - continuing.

2. Provide information and assistance to appropriate personnel within PM USA regarding fumigations - continuing.

3. Provide information and assistance to appropriate personnel within PM International regarding pest control - continuing.

4. Conduct experiments in area of efficacy testing to determine alternate methods for pest control - continuing.

Resource Allocation: On the average, 2.5 persons projected for 1988.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO MICROBIOLOGY

Objective: Provide support in a timely manner to various PM USA programs in areas of microorganisms. This information is frequently combined with analytical and subjective data to form a more complete picture.

Status: Support is requested to support various programs in the area of microorganism populations and alternate processing techniques to reduce organism populations.

Strategies: Use appropriate microbiological techniques to determine organism population and aid in investigations to reduce populations.

Tactics & Timetable: Provide microbiology data to support various programs such as The Alternate Humectant Program, Tobacco Storage Container Study, Project Delta, Project ART, Burley Spray and other programs as requested - continuing.

Resource Allocation: Projected for 5 persons in 1988.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

TOBACCO SHEET IMPROVEMENTS

Objective: Investigate alternate methods in sheet production area to improve sheet products.

Status: Support efforts to improve quality of PM USA sheet products by investigating alternate methods of production.

Strategies: Utilize the Pilot Plant to investigate alternate methods of sheet production and process improvements.

Tactics & Timetable

1. Evaluate alternate Yankee Dryer release agents to improve baseweb release from the dryer surface - continuing.

2. Support efforts to reduce humectants in sheet material - continuing.

3. Investigate replacement of dry flavors with liquid flavors to improve flavor dispersion in RCB and reduce thickening and recycle of size in RL - continuing. Provide Pilot Plant and process development for miscellaneous projects - as requested.

Resource Allocation: Projected for 2.5 persons in 1988.

2021555968

Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

SEMIWORKS SUPPORT

Objective: Provide cigarette fabrication in a timely manner to support PM USA programs.

Status: As a small scale fabrication unit, the Semiworks is requested to provide cigarette production to evaluate new blends, new processes, new materials, etc.

Strategies: Provide cigarette fabrication on an as needed basis for analytical and subjective testing.

Tactics & Timetables

1. Support the Marlboro Standardization Program - as needed.
2. Support flavor modifications - as needed.
3. Support the Offshore Tobacco Reduction Program - as needed.
4. Support efforts to improve the processing plants - as needed.
5. Support the TLA program - continuing.
6. Provide cigarettes to support marketing efforts - as needed.

Resource Allocation: For this effort, 6 persons are projected for 1988.

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Source: https://www.industrydocuments.ucsf.edu/docs/ryhm0000

BURLEY SPRAY PROGRAM

Objective: Determine the level and uniformity of application of burley spray to strip by measuring selected chemical components of the burley spray to support efforts to standardize and/or improve burley spray application.

Status: There is a current effort to evaluate alternate drying of burley strip and to standardize the application of burley spray in all Primaries.

Strategies: Provide analytical data to support the above efforts.

Tactics & Timetables

1. Provide chemical analyses of strip produced under a variety of drying conditions - as needed.

2. Provide chemical analyses of volatiles lost from the dryer as a function of dryer conditions - as needed.

3. Analyze components of burley spray to determine their possible use as predictors of application - continuing.

4. Investigate microscopy and image analysis as tools to determine the uniformity of burley spray application - 3rd quarter.

Resource Allocation: It is anticipated that 3 persons will be devoted to this activity in 1988.

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SUPPORT THE CURRENT BUSINESS

Objective: Provide analytical support on an as needed basis to various PM USA programs.

Status: There are a number of on-going programs which require analytical support from time to time. In addition, special questions arise which can usually be answered in a short time.

Strategies: Support the current business in a timely manner.

Tactics & Timetables

A partial listing of programs in this area is given below.

1. Marlboro Standardization - standard run #6 is planned for September, 1988. In addition 4-6 factory pickups for analyticals and subjectives are anticipated for 1988. (2)

2. Provide CI type information on cigarettes as requested. (2)

3. Provide chemical analyses to support the tobacco storage container study. (1)

4. Provide support in areas of analytical methods, standards and measurement development. (3)

5. Provide support to develop test methods for measuring packaging solvents and transmit to QA for monitoring. (1)

6. Investigate the use of an Infralyzer for either on or off-line analysis of triacetin in filter plugs. (1)

7. Conduct viscosity and inkometer studies of printing inks used in factory locations. (1)

8. Conduct simulator studies and TGA analyses of tipping adhesives, develop instron procedure for characterizing adhesive-paper bonds. (1)

9. Investigate the use of relative humidity to develop a rapid procedure for moisture determination in the stemmeries. (1)

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CONFIDENTIAL

TECHNOLOGY ASSESSMENT UPDATE 3 AUGUST 1988

The strategies and tactics for the Technology Assessment Program remain essentially unchanged and are generally progressing well. We summarize below the current status of the program.

STRATEGY 1: Develop and maintain a current assessment of strategic science and technology needs.

A Technology Assessment Steering Committee was formed. Members are H. G. Burnley, J. L. Charles, W. J. Campbell, A. Dixon, C. E. Horner, K. S. Houghton, D. B. Knudson ,W. F. Kuhn, A. C. Lilly, J. L. Myracle, T. S. Osdene, B. A. Semp, W. P. Taylor and F. M. Watson. The Steering Committee met several times to define important needs and set priorities. Quarterly meeting are planned.

The Steering Committee nominated senior staff from their areas to constitute the Technology Assessment Working Committee. Committee members are W. E. Claflin, D. C. Cole. C. R. Hayward, J. M. Hill, B. C. LaRoy, A. C. Lilly, P. Martin, D. E. Merrill, T. A. Newman, L. X. Nghiem, M. D. Rosenberg, E. B. Sanders, B. A. Semp, M. F. Suter and J. F. Whidby.

The functions of the Working Committee are to: **Identify** areas of science and technology of potential importance to current and future technical strategies. **Assess** the applicability of new technologies to "real world" needs. **Recommend** internal or contract programs to develop appropriate technologies and/or adapt them to our needs. **Recommend and facilitate** the implementation of appropriate technologies.

The Working committee has reviewed immediate needs and technology related issues and selected three technology areas for initial emphasis. These are: (1) paper and adhesives, (2) expert systems and (3) optical inspection. The Working Committee has also given considerable attention to the strategies and tactics of **implementing** important and well targeted technologies. This group meets monthly.

An R&D Technology Assessment Group was formed under the leadership of Cliff Lilly. Members are Chuck Hayward, Bernie LaRoy, Ted Sanders and Hazel Stewart (secretary.) Technologies for the Delta Program currently require about 2/3 of the time of this group. The remainder is devoted to working with the above Committees and to supporting the to strategies 2 and 3 below.

STRATEGY 2: Develop and maintain current technical awareness of the broad bases of science and technology which will supply our future needs.

Broadly based literature searches were carried out with the help of the Technical Information Section. The Computer Applications Division has configured a full text searching routine for our use to allow

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rapid review of the extensive files generated. We plan to extend this resource as new topics are studied by the Working Committee and the R&D group

Extensive monitoring of the state-of-art in high energy, high discharge batteries continues in support of the Delta Program.

Membership in the Fluid Properties Research Institute (Georgia Tech.) was initiated on July 1, 1988. This membership provides access to an extensive set of thermodynamic and critical property data available from no other source. It also maintains our contacts with the outstanding School of Chemical Engineering at Georgia Tech.

High intensity ultraviolet irradiation was investigated as a possible way to reduce TSNA's. Experimental work at Maxwell Labs is expected to take place during August.

The field of neural processing was investigated. This rapidly growing field has potential for artificial intelligence, pattern recognition and machine vision applications. A small commercial system has been ordered for evaluation.

STRATEGY 3: Coordinate the "acquisition" of appropriate expertise in science and technology areas of potential importance to the Company.

We summarize below some activities in which the Technology Assessment function has been directly involved. There are, of course, numerous other outside interactions being pursued by R&D.

The Optical Processing Program in collaboration with Engineering and IS continues to make good progress. A patent has been filed (assigned to PM) on the Hough Transform Techniques for product inspection developed at Carnegie Mellon University. A prototype commercial Fourier transform device was investigated by R&D and Engineering. Work is continuing to overcome drift problems in this otherwise promising instrument. Optical correlation techniques are under development by the R&D group.

Molecular jet research in collaboration with Colorado State University continues to provide valuable information about flavor molecules. The new work in aerosol formation is progressing well as we obtain a better understanding of molecular jet kinetics.

Calculations of the water-glycerol system in collaboration with VPI & SU have made significant contributions to our understanding of "humectants."

Work at UVa and VPI continues to provide important information on the behavior of metal alloys in the environment of the ART process. Work is beginning at VPI on the effects of thermal cycling.

Work in membrane separations with Sepracor Inc. is progressing well toward its objective of removing nicotine from aqueous solutions. The

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development of an ion exchange compound by the Chemical Research Division has significantly advanced the program.

For the Delta Program, initial contacts were made with battery companies. These discussions can be resumed when product specifications are better established.

Joint programs have been established with VPI and New York Polytechnic University to investigate the application of sol-gel technology to the development of refractory papers. These papers can be utilized in a number of different potential new products.

Investigations have been initiated regarding the use of spent yeast as an encapsulating medium for certain flavors. The technology involved was developed by a small company in the U.K. We are collaborating with Miller Brewing R&D.

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PLANS AND OBJECTIVES FOR TECHNOLOGY ASSESSMENT
1988

OBJECTIVE:

Ensure that R&D maintains appropriate awareness, knowledge and expertise in strategic areas of science and technology which will be needed by Philip Morris USA in the future (5-15 years).

BACKGROUND:

The technology awareness function has evolved over the last several years. The initial objective was to increase the motivation of the professional staff to maintain interests in current technologies. This was pursued through activities such as a series of lectures in Condensed Matter Physics by prominent scientists and the establishment of the Visiting Scientist Program.

More recently, emphasis has been placed on the identification and assimilation of important new areas of science and technology. Activities in this area have included:

Development of facilities and expertise for molecular property calculations.

Support for the establishment of a program to use molecular jet techniques to examine the structure and formation of small molecular clusters.

Establishment of a program to characterize the corrosion behavior of metal alloys in tobacco processing environments.

Identification of optical transform technology as an area offering great potential for high speed product inspection and process control. Establishment of a cooperative program in this area with Engineering, Information Services and Carnegie Mellon University.

Identification of membrane separation technology as an area of potential value in low nicotine and flavor areas.

Initiation of programs to increase our expertise and capabilities in battery technology in response to the needs of the Delta Program.

The program has developed under Cliff Lilly's leadership. Bernie LaRoy was officially assigned responsibilities in the area in August, 1986. Help in particular areas has been enthusiastically provided by many members of the professional staff.

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STATUS:

1. Calculations of humectant properties in collaboration with VPI&SU are producing excellent results.

2. A new phase of research with Colorado State University is beginning to examine the energies of formation of small clusters. This work will complement thermodynamic calculations of aerosol formation in progress in Physical Research.

3. Continuing studies with the University of Virginia support the use of stainless steels (instead of more expensive alloys) in our high pressure processes. Current discussions involve extending the work to the study of stress induced by thermal cycling and shock.

4. The Optical Processing Program in collaboration with Carnegie Mellon University has been located in the Physical Research Division. An optical pack inspection apparatus will be tested on production machinery during the next quarter. A patent position has been established for the use of Hough transforms in product inspection.

5. Discussions with Sepracor, Inc. have resulted in a technical proposal for the separation of nicotine from process water. A contract will be recommended to management shortly.

6. An extensive review of current technologies in high discharge batteries was carried out. Discussions have been held with two battery companies (Polaroid and Varta Batterie AG). Collaborative development programs with each are under consideration.

In addition to the above areas where active involvement now seems appropriate, we are also maintaining current awareness in areas which include: high temperature superconductors, neural processors, critical phenomena and remote sensing.

STRATEGIES AND TACTICS:

Strategy 1: Develop and maintain a current assessment of strategic science and technology needs.

Tactics:

1. By March 1, 1988, develop initial lists of (a) the fundamental scientific advances needed by R&D to carry out its strategic plan and (b) the future technology needs of Engineering, Q.A., I.S., and T.T.G.

2. Continually maintain and refine this list through regular discussions with R&D senior technical staff and program coordinators as well as with representatives designated by the above departments.

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Strategy 2: Develop and maintain current technical awareness of the broad bases of science and technology which may supply the above needs.

Tactics:

1. Cultivate and maintain an increased number of contacts with university, government and industrial laboratories engaged in state-of-the-art research and development. Encourage our technical staff to maintain active interests in areas which may be outside of their current assignments. Review appropriate technical journals, participate in meetings and conferences.

2. Support and maintain the Visiting Scientist Program to select and bring to Philip Morris leading technologists whose work may be of value. Encourage and promote the exposure of the technical staff to these individuals.

3. Utilize the Evening Seminar and Technical Seminar programs to increase our exposure to emerging or changing fields. Suggest appropriate external and internal speakers to the seminar committees.

Strategy 3: Coordinate the "acquisition" of appropriate expertise in science and technology areas of potential importance to the Company.

Tactics:

1. Identify important areas in collaboration with R&D and Operations personnel.

2. Assess the degree of involvement necessary. We may need to maintain awareness, learn to use a new technology, or take a leadership role in its development.

3. Recommend new science and technologies which should be "brought in" to R&D:

   Recommend attendance at appropriate courses or seminars and/or the acquisition of capital equipment for evaluation.

   Establish appropriate collaborative sponsored research programs with universities or "entrepreneurial" companies. Target the establishment of at least four new programs in 1988.

   Establish appropriate working relationships inside of R&D and with other departments. (Similar to the cooperative development of Optical Processing.)

   Facilitate the transfer of promising technologies to the appropriate "customer."

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RESOURCES:

Personnel:

Proper execution of the above program will require the services of four senior technical personnel. These individuals must be competent over a broad range of technologies. They must also be able to "sell" the need for technologies to management, establish good working relationships, and negotiate appropriate contractual relationships. The initial technical staff under Cliff Lilly's direction is expected to consist of: one Principal Engineer, one Associate Principal Scientist, one Associate Senior Scientist, and one Secretary. To function properly, the group will need a full-time secretary. In addition to acting as general secretary to the group, this individual will create and maintain files of technical information, contracts and business arrangements.

Financial:

Anticipated budgetary needs for 1988 are:

1. Visiting Scientist Program: $125,000.

2. R&D Contracts: Funds for the establishment of initial, exploratory work with universities or companies: $500,000.

Note: Funds for battery development programs have been included under Delta-2.

IMPACT ON OTHER AREAS:

The program affects R&D in several respects:

1. The senior people requested from other areas may need to be replaced.

2. The program will require extensive help from the Technical Information Section to establish and maintain state-of-the-art awareness in a broad range of areas.

3. The program will require help and cooperation (time and interest) from the senior technical staff.

4. To be effective, cooperative development programs with universities require the active collaboration of our scientists and engineers.

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Initially, other Richmond departments will be asked to designate representatives to interact with the program. This could amount to 1-2 days per month. By the end of the year, we hope to establish cooperative development efforts which may involve full or part-time staff from R&D and one or more other departments.

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Delta

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